19 DECEMBER 1958

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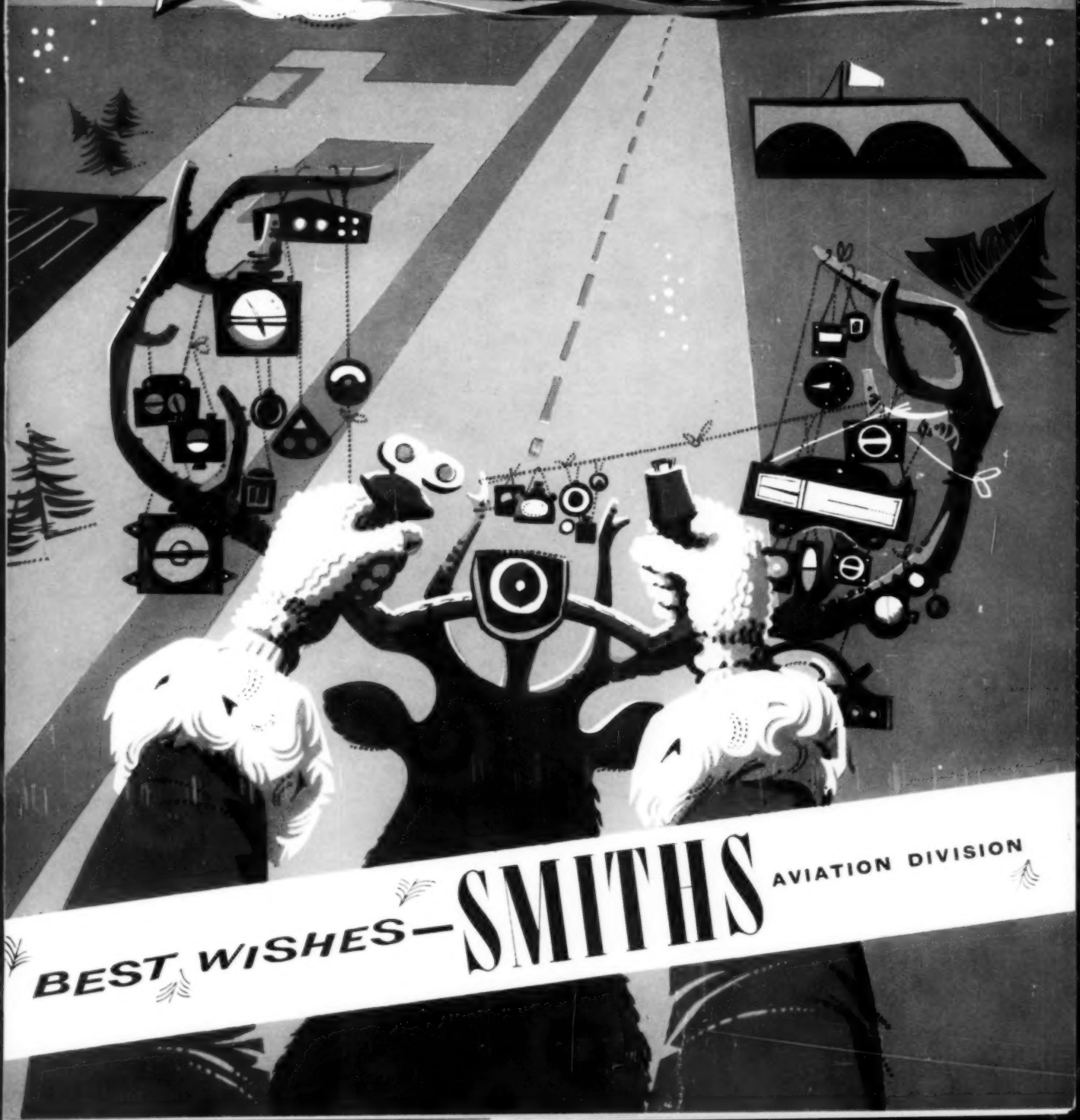

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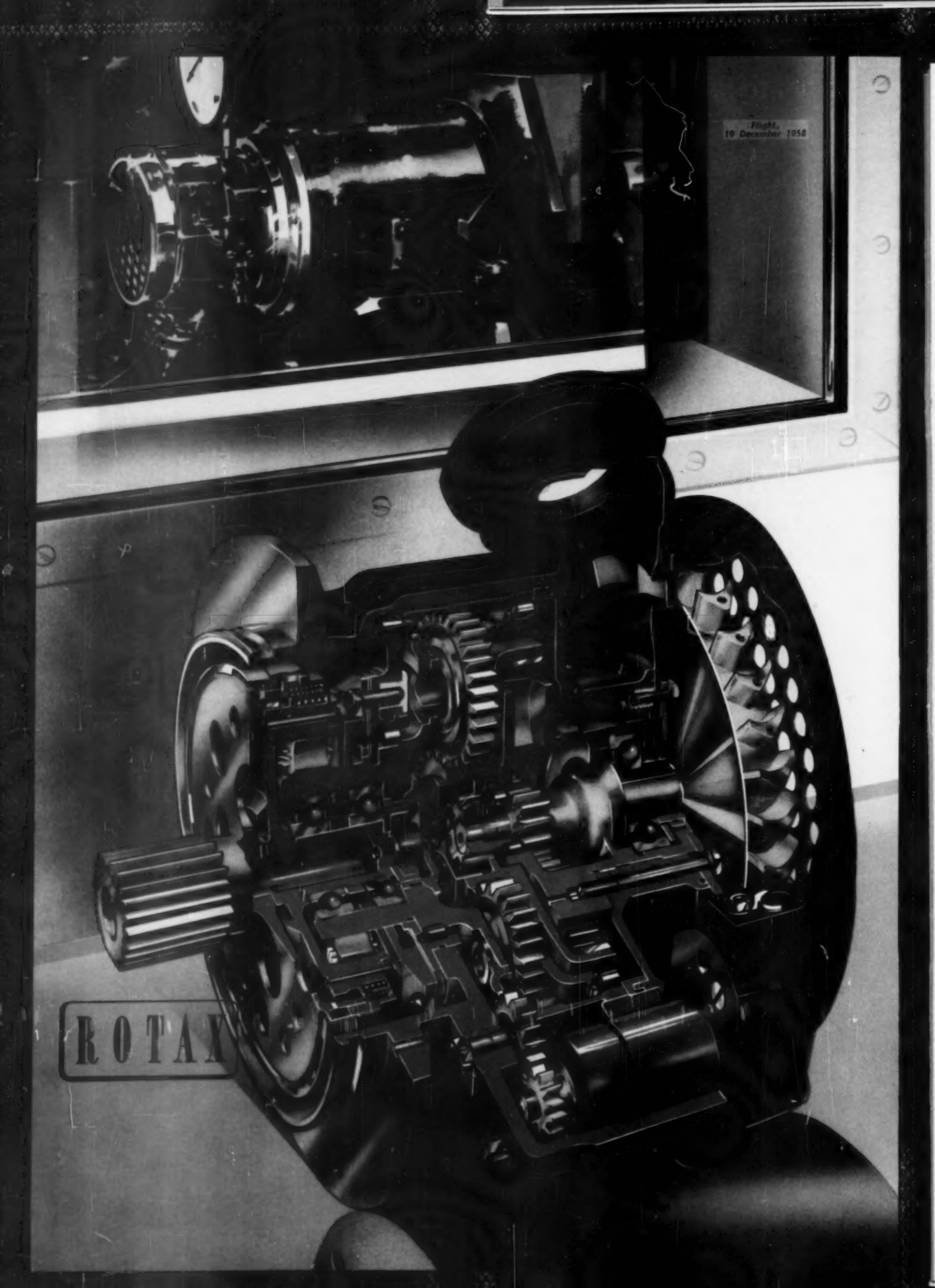
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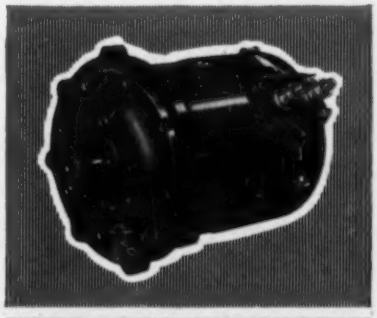

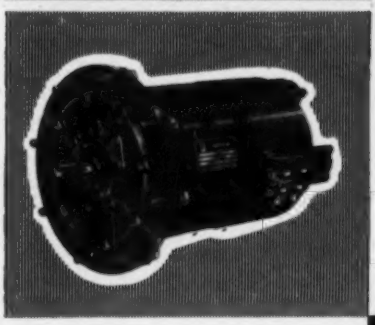

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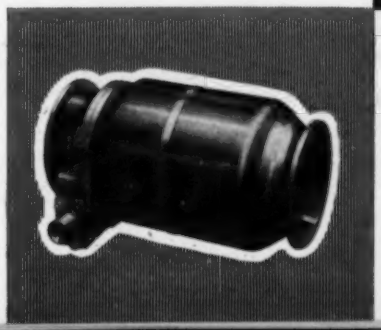

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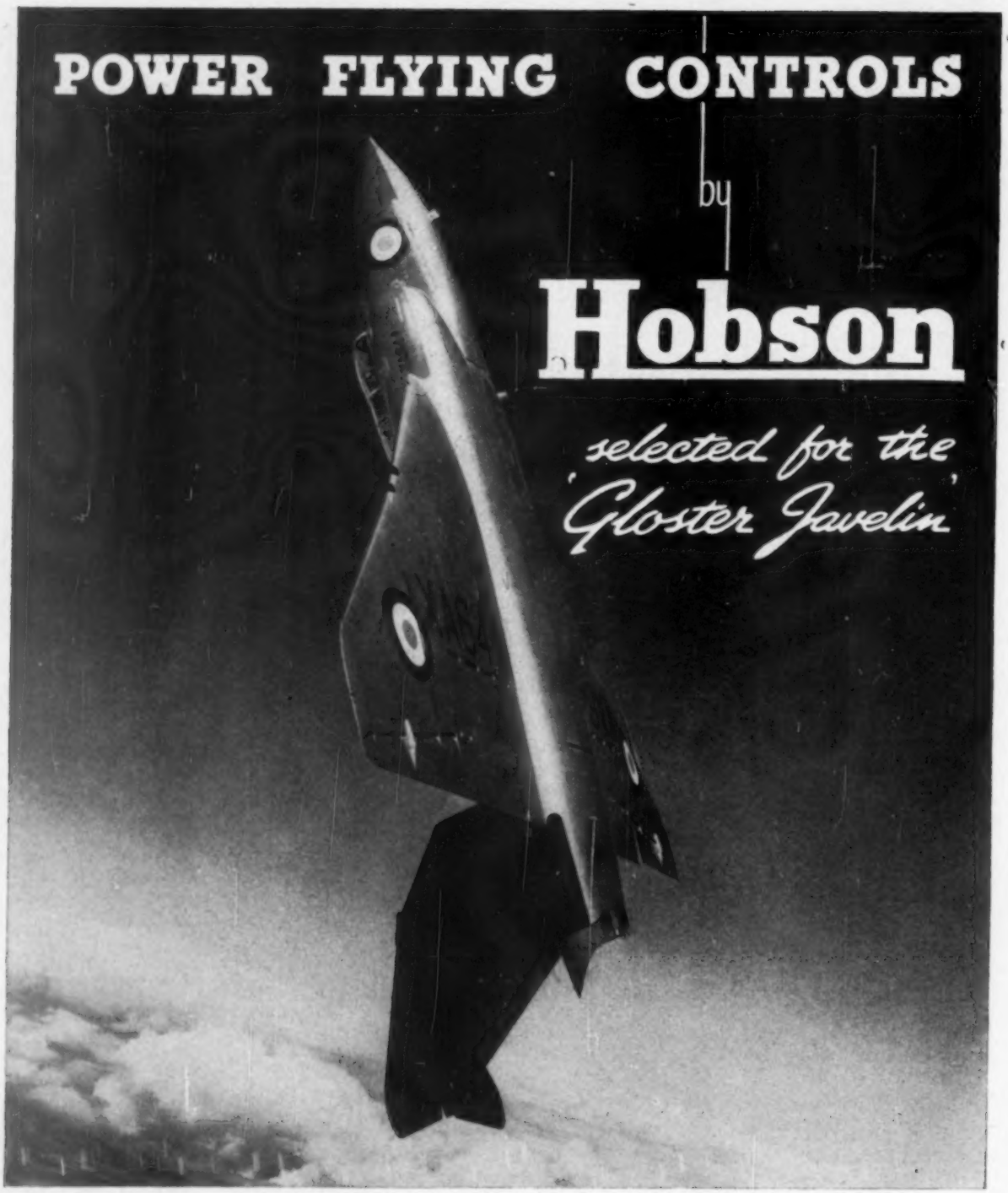

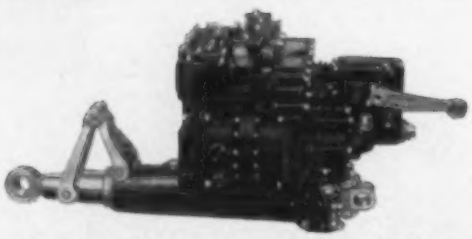

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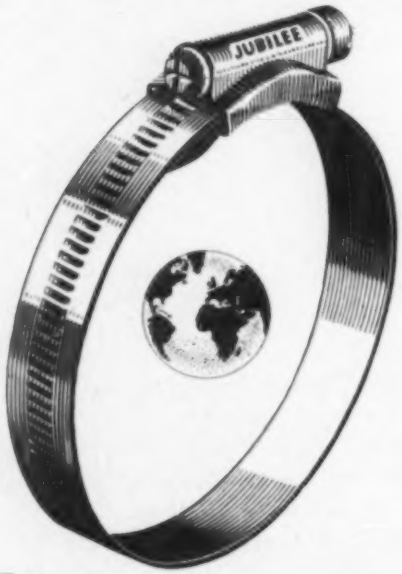

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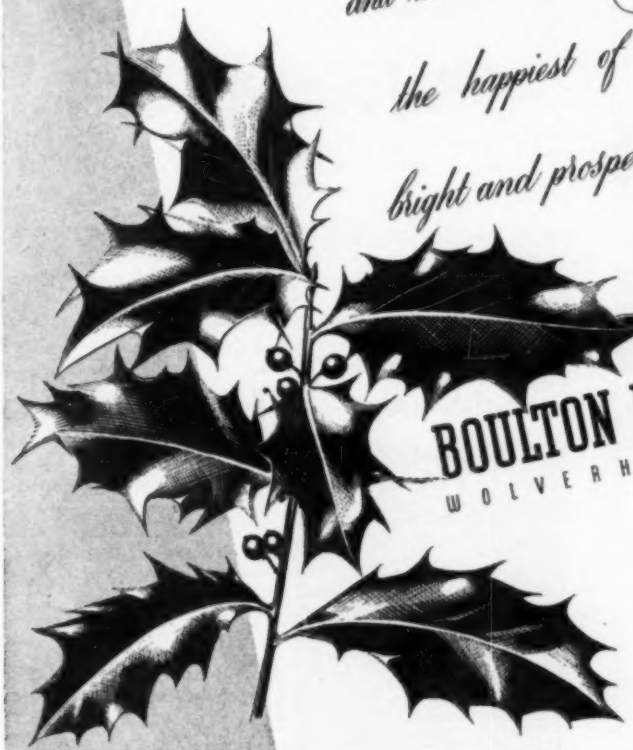

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

FLIGHT
and
AIRCRAFT ENGINEER

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Beyond the B.O.A.C. Inquiry

THE report of the court of inquiry into the B.O.A.C. dispute at London Airport in October came out last week. A brief summary of its findings appears on page 949. The Court has done, with creditable promptness, what it was called upon to do. It has examined the workings of the industrial negotiating machinery, shown how it was improperly used by "disruptive elements," and has rebuked certain personalities. The machinery itself has been criticized, and we believe that, as a result, it will operate all the more smoothly in the future. But it is a pity that the *real* causes and circumstances of the dispute were not within the Court's terms of reference. It is not enough to examine the operation of labour-negotiating machinery: we are still left with the question as to why the machinery became so severely strained.

The reasons, as we see them, are twofold. One is peculiar to our Airways Corporations, the other to the general airline re-equipment revolution.

First, because B.O.A.C. and B.E.A. are State-owned, they appear—ironically—to be particularly susceptible to political disruptions. It has been said that the workpeople in State-owned industry tend to think that the Government, rather than the management, is answerable for their problems, and that more control of policy is their due. This was one of the root causes of the B.O.A.C. dispute, and until it is given an airing disputes may continue.

The other reason for the *malaise* (and one which likewise needs examination) is not peculiar to B.O.A.C., though applicable. Not only was the full introduction of the Comet 4 hampered by labour trouble. Pan American's Boeing 707 services were, and still are, curtailed by dissatisfied union-members. The introduction by Eastern Air Lines of Lockheed Electras has likewise been similarly delayed. Looking back, B.O.A.C. had labour trouble when they introduced Britannias. And today half-a-dozen airlines in America are grounded or disrupted by dissatisfied employees—flight engineers, maintenance engineers, and pilots.

The pattern is clear. When airlines put more productive tools into operation, which they do every year (more this year and next year than ever before), the employees feel that they have a right to more money—without redundancy. Until the economics of this problem are independently thrashed out the airlines may find their new aircraft an industrial embarrassment.

V-force or S-force?

THE present state of East-West relations—equilibrium on the surface, but turbulence beneath it—may be partly attributable to the setting up of mighty deterrents designed to discourage overt and large-scale aggression. Yet each new deterrent is succeeded by a counter-deterrent, then a counter-counter-deterrent, and so on. This suggests that the only way of keeping ahead is either to diversify the threat by adopting a multiplicity of methods of delivery or to adopt a single method which offers the most elusive target to the defences.

It is now the prerogative of the richer nations to diversify and the Hobson's choice of the less rich to seek the single, elusive technique. Britain has for some years hovered unhappily between riches and poverty; but the recent Anglo-American agreement on the exchange of information has brought unexpected results, and it is probable that the Defence Committee of the Cabinet is now able to choose from many more possibilities. In any case, the R.A.F. seems likely to receive, a number of years from now, a British supersonic, general-purpose aircraft more or less based on OR.339.

There remain two prospects. First, of "economizing" by discontinuing much of our own research and accepting ready-made American weapons or techniques. Secondly—and this may be to the aircraft industry the even more unpleasant possibility, since licence-production might palliate the first—of eventually transferring the main responsibility for the deterrent mission from the R.A.F. V-bomber force to a force of Royal Navy missile-firing submarines.

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FROM ALL QUARTERS

FAST, FASTER . . . After opening Preston's high-speed by-pass, the Prime Minister, Mr. Macmillan, visited English Electric at Warton and inspected the Lightning. He is seen with Mr. R. P. Beamont, chief test pilot and manager of flight operations. *(See upper picture, p. 956)*

TANDEM TRIO: Production of the Bristol 192 multi-purpose helicopter for the R.A.F. (two Napier Gazelle free turbines) is now well in hand at the company's Weston Division. Below are seen three examples with different front-fuselage installations; the nearest machine's front and centre sections have just been joined

Russian ICBM Claim

ON his return from a visit to the Soviet Union, Senator Humphrey (Democrat, Minnesota) spoke to the Press of his eight-hour talk with Mr. Krushchev. He said that the Soviet leader told him that Russia had developed a ballistic missile capable of delivering its warhead over a range greater than 8,000 miles and was also in possession of a small, compact thermonuclear bomb with a yield of 5 MT. The Soviet stockpile of nuclear weapons was already greater than was needed and some were actually being dismantled (presumably to release fissile material for other purposes).

R.34 Memorial Protests Heeded

SINCE our report on the protest by the Guild of Air Pilots and Air Navigators against the proposed sculpture for the R.34 memorial at London Airport went to press (this issue, p. 938), the Air League of the British Empire has announced its decision not to proceed with the design. The decision has been taken "in view of the overwhelming opposition expressed from all sides of the aviation world."

In its statement, the League says it has "reached this decision reluctantly since Mr. Lynn Chadwick's stimulating design had the approval of the Royal Fine Art Commission and the architect of the new terminal building at London Airport."

The statement continues: "While the League does not feel that the aviation community is qualified to judge the artistic merits of the proposed memorial, it has, the League appreciates, a very deep and real interest in providing a suitable commemoration of the R.34's epic double crossing of the Atlantic in 1919. It is because there has been such widespread and obviously sincere objection to the suitability of Mr. Chadwick's design for this purpose that the Council of the Air League have decided not to proceed further with it." An alternative form of commemoration—possibly by a plaque—is being considered.

Balloon Adventure Begins

THE attempted Atlantic crossing by a free balloon began early last Friday morning, when the 53,500 cu ft craft *The Small World*, G-APOB, ascended from El Medano beach, near Tenerife, Canary Islands. W/C. R. S. Booth, the veteran airship pilot, directed the launching operation.

The aim of the crew—A. V. Eiloart and his son and Colin Mudie and his wife—is to make a landfall in the West Indies after a 3,000-mile voyage that may take anything from ten to thirty days. The balloon, which has a car convertible into a sailing boat, was described by Colin Mudie in a special article in *Flight* for November 21.

It was believed that by Sunday night the balloon had travelled some 700 miles.

Cryptic Answer

WHEN Sir A. V. Harvey asked the Minister of Supply in the Commons last week what amounts of Government money had been earmarked for research on manned aircraft and aero-engines during the fiscal year 1958-59, and for comparative figures of actual expenditure in 1956-57 and 1957-58, Mr. W. J. Taylor (Parliamentary Secretary, M.o.S.) said it would not be in the public interest to disclose the figures. But he added: "I can, however, say that the total for 1958-59 is slightly larger than for 1956-57 and slightly smaller than for 1957-58."

NACA into NASA

VIRTUALLY all facilities, personnel and programmes of the defunct American National Advisory Committee for Aeronautics (NACA) have now been taken over by the NASA, or National Aeronautics and Space Administration. In addition, the Administration are utilizing, on a co-operative basis, the U.S. Army's great research centre at Redstone Arsenal, and were also awarded control of the Army's Jet Propulsion Laboratory of Caltech on December 3. NASA's wide authority is proving embarrassing to the Air Force's Advanced Research Projects Agency; at present ARPA is scheduled to be closed down next March, and it has already surrendered most of its projects to the NASA.

New H.P. Chief Engineer

NEW chief engineer of Handley Page, Ltd. (succeeding Mr. W. H. MacRostie, who recently retired after forty years' service), Mr. K. C. Pratt, A.M.I.Mech.E., A.F.R.Ae.S., joined the company in 1934 and has been concerned in the development of the Harrow, Hampden, Halifax, Hastings, Hermes and Victor. He was appointed test and development engineer in 1951 and has since been in charge of the Park Street works, on structural testing and flight development. He became deputy chief engineer in 1956.

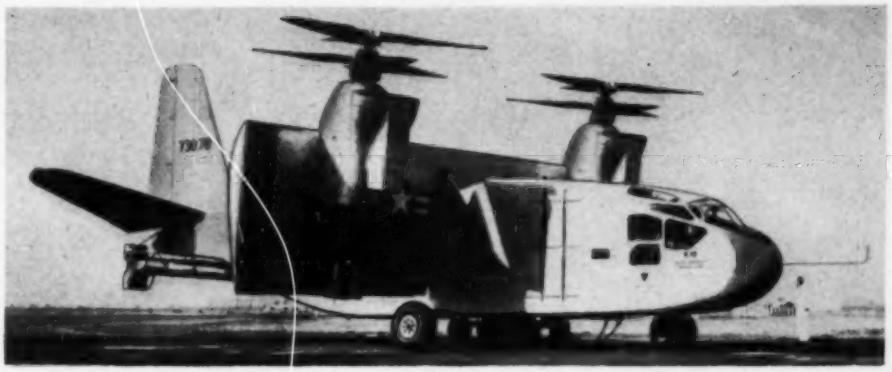
Mr. Pratt

World Congress of Flight

AT Las Vegas, Nev, the first World Congress of Flight is to be held next year, from April 12 to 19. It is sponsored by the Air Force Association in co-operation with other U.S. bodies, and the promoters define its purpose as that of bringing together all those engaged in aviation to unite them in the common cause of "the advancement of aeronautics and astronautics, the twin sciences of flight."

It is stated that the meeting "will combine conferences and demonstrations, private meetings and personalized consultations."

European representative for the congress is Mr. Gene Murphy, head of Carl Byoir and Associates, International, 12 Rue Boissy d'Anglas, Paris 8.



***TILTING AND WINDMILLS:** Now undergoing engine-runs at Palo Alto, Col., is the experimental tilt-wing Hiller X-18 of the U.S.A.F. Powered by two 7,000 h.p. Allison T40 double turboprops, each coupled to a six-blade Curtiss contra-prop, the X-18 is a conversion of a former Chase C-122 Avitruc transport. The stubby wing is shown in the VTOL position with verticla thrust. For pitching control at low airspeeds a Westinghouse J34 turbojet feeds upward- and downward-facing nozzles at the tail*

Air Commerce and the City

FIFTY years is only a very short period in the history of an ancient city like London; but it is approximately the life of the aeroplane, and it has taken only half this time for air commerce to assume its place of importance in the affairs of the city.

A second event of great significance to the Guild of Air Pilots and Air Navigators in the business life of the city (the first was the granting of livery) took place on Thursday of last week, when a window displaying the Guild's coat of arms was unveiled in the Baltic Exchange. This is the first architectural feature in the Exchange to mark its newest activity of air charter and air transport business and thus the Guild's arms take their place alongside those of the Honourable Company of Master Mariners, the Worshipful Company of Shipwrights and the Worshipful Company of Farmers.

The window was presented by the late Captain Alfred Instone and was unveiled by Mrs. Instone in the presence of the chairman of the Exchange, Mr. Richard D. Hyde; the Master of the Guild, Sir Frederick Tymms; and Freemen and guests. In an introductory speech the Master spoke of the Guild and of early air activities in the Baltic Exchange. Thanks were expressed to Mrs. Instone by Captain O. P. Jones, who recalled that he flew for Instone Airlines on the London - Paris route and well remembered the great enthusiasm of Captain Instone. Mr. Hyde expressed thanks to the Master and Guild.

It is interesting to recall that the first air charter-party negotiated through the Baltic Exchange was signed in 1928, which was about the time the Guild of Air Pilots and Air Navigators was formed. The air-charter activities of the Baltic are now marked by the wings appearing in its coat of arms.

IN BRIEF

The Australian Government on December 4 took administrative action to extend the Woomera rocket range to a length of 1,250 miles.

* * *

Next week's issue of *Flight*, dated December 26, will be on sale on Christmas eve and will contain seasonable features.

* * *

The U.S. Army's next attempt to send a rocket to the Moon—probably about February 1 next year—may be the United States' last Moon-probe attempt until mid-1959, according to Defense Department officials.

* * *

The first field artillery missile battalion of the U.S. Army to go overseas equipped with the Redstone medium-range ballistic missile (described in our issue of May 23 last) is now reported to be "completely operational" at Engelheim, Western Germany.

* * *

According to Erik Bergaust, editor of the American journal *Missiles and Rockets*, the Soviet Union recently fired a space vehicle which "passed the Moon and went out beyond Mars." He stated that American scientists had tracked the Soviet vehicle for three days.

* * *

Earlier this month a prototype Lobber was fired for the first time at Camp Irwin, California. Designed and developed as a private venture by Convair, Lobber is a rocket-propelled vehicle intended for the resupply of surrounded forward troops and for several other battlefield functions. Some 6ft in length, it reaches 1,500 m.p.h. and lands by parachute on its shock-absorbing nose-cone.

* * *

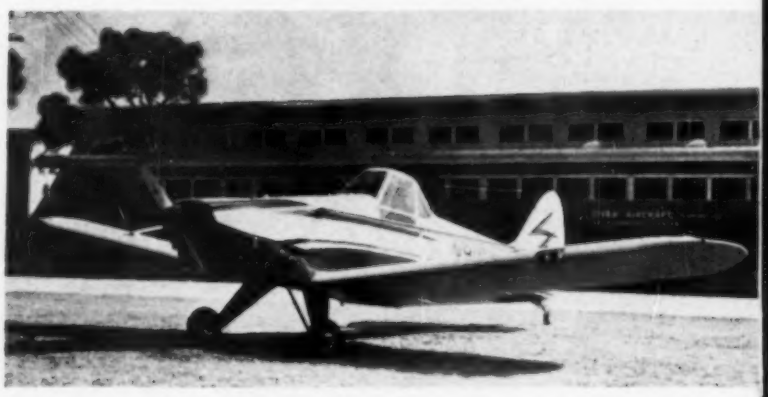
In reply to a Commons question last week, the Parliamentary Secretary to the Admiralty, Mr. Robert Allan, said, "As Polaris has not yet been fully proven or tried out in the United States, it is difficult to say what adjustments will be necessary to submarine hulls, but, certainly, some would be necessary, as otherwise our Dreadnought hull would not be able to take Polaris."

* * *

Northrop Aircraft have received a $16,926,000 contract as the first appropriation for full production of the T-38A supersonic trainer. The first T-38 was rolled out in August, but G.E. have yet to deliver the pair of afterburning J85 engines and the aircraft is not likely to fly for at least another month. A second prototype, a static-test airframe and four service test and evaluation machines are near completion.

***COLLEGE JET:** Delivery flight of this Morane-Saulnier MS.760 Paris (below) from Villacoublay to the College of Aeronautics, Cranfield, was made on December 10. Left, pilots A. J. Macdonald and I. A. Robinson are greeted on arrival at Cranfield by W/C. C. G. B. McClure, head of the College's Department of Flight. The aircraft will be used for advanced instruction in aspects of aerodynamics and propulsion*

A NEW AGRICULTURAL PIPER



The PA-25 Pawnee, seen in front of the Piper development centre at Vero Beach, will go into limited production next year. Power unit is a 150 h.p. Lycoming

FIRST project of Piper Aircraft Corporation's development centre at Vero Beach, Florida, is the PA-25 Pawnee, a low-wing agricultural aircraft powered by a 150 h.p. Lycoming. The new machine was designed under the direction of Fred E. Weick and is to go into production next year.

The Pawnee can be used for the aerial application of either liquid or dry chemicals. At a gross weight of 2,300 lb it carries a useful load of 1,100 lb and its hopper capacity is 110 gal or 20 cu ft. The cockpit has been placed as far aft as possible in the interests of pilot safety, and as high as possible to provide maximum vision. Designed for operation from short, rough fields close to the dusting or spraying area, the PA-25 has performance characteristics similar to those of the agricultural PA-18A.

Although the Pawnee is a completely new design it incorporates many components which have been proven in other Piper types. Wings, flaps and ailerons are derived directly from those of the Super Cub, but are strengthened because of the increased gross weight. The powerplant is the same as that of the Tri-Pacer. The landing gear is similar to that of the Pacer, using an internal Hydrasorb shock-absorbing system. Tri-Pacer axles, Comanche wheels and brakes and Apache tyres are used.

In overall configuration and design concept, however, the Pawnee is entirely new. For reasons of safety, a determined effort was made in the design (a) to provide an ample field of view and satisfactory lateral control at low speeds, (b) to ensure the minimum retarding or deflecting effect in flying through or past wires and (c) to protect the pilot as far as possible in a crash. These aims were achieved by adopting the low-wing layout and placing the pilot high in the fuselage; providing a sharp leading-edge on the landing-gear struts, together with a cable from the top of the cockpit to the top of the rudder; and placing the pilot behind all heavy objects or loads, supporting him with a strong harness and in a well-designed cockpit, and providing as much wing and fuselage structure ahead of him as possible.

In detail design, again, considerable effort has been devoted to minimizing the effects of a crash, and all the design recommendations of the Aviation Crash Injury Research Unit for crash survival have been followed—with the exception that the fuel tank is located in the fuselage, for simplicity, and not in the wing.

Much attention has been paid to resistance to corrosion, and the hopper/tank, which is located approximately on the c.g. of the machine, is made of polyester plastics reinforced with glass-fibre. The spraying equipment employs a 1in Simplex centrifugal pump and boom-mounted nozzles behind and above the wing trailing edge. For dry chemicals a venturi distributor has been developed.

Production of the Pawnee is scheduled to get under way during the first quarter of 1959 at the Piper plant at Lock Haven, Pennsylvania. A few deliveries are expected in the spring but production will be limited to a service evaluation quantity until full tooling is completed later in the year. The first machines will be used for an evaluation of the aircraft and its chemical dispersal equipment in a variety of operating conditions and areas.

YOUNG PERSONS' GUIDE TO THE INDUSTRY

WHEN Mr. E. C. Bowyer, director and chief executive of the S.B.A.C. (though on this engagement expressing personal views), lectured on *The Future of the British Aircraft Industry, 1958*, to the R.Ae.S. Graduates' and Students' Section on December 9 he wisely put his subject into historical perspective for the benefit of his audience; and he further stressed that it was people of their age—an age at which Newton, Faraday and Sir Frank Whittle had made their first discoveries—who had the most vital contribution to make to the industry's future.

Mr. Bowyer recalled two incidents in the early 1930s, when the industry's total turnover was less than £10m a year. On one occasion he had visited an aircraft factory and been shown its latest project—forlornly shrouded with a tarpaulin; on another, an executive had pointed to grass sprouting through the concrete in the workshops and asked, "What are we going to do about this?" He further reminded his listeners that we might not have won the Schneider Trophy—with all that it meant in the development of the Spitfire—without the gift of £100,000 from Lady Houston. The crisis in the early 1930s had something in common with the present state of affairs, which was not unprecedented.

Putting his subject next into a contemporary perspective, the lecturer said that the industry was one which went far beyond the manufacture of aeroplanes; and it was still in a state of growth. Moreover, it was one of the biggest employers of labour: 330,000 people were working in the industry and its ancillaries; and with those employed on missiles, not fewer than 1¼m men, women and children depended for their livelihood upon it. The industry made a notable contribution to the country's exports, accounting for 11 per cent of them this year and nearly £800m worth since the war.

Having thus set the scene, Mr. Bowyer came down to what was needed. Research and development must not be allowed to sag; they were the lifeblood of the industry. Thus the first need was Government help for research. Secondly, there should be no delay in the issue by the Government of specifications for certain types of aircraft foreshadowed in the White Paper. Thirdly, a dependable indication was wanted of the size of Government orders.

The lecturer then proceeded to deal with certain topics he had been asked specially to mention. He said he was against nationalization of the industry. Rationalization could be "a fairly arbitrary affair"; much of the emphasis placed on it sprang from inaccurate information. Amalgamation was a natural process and had been going on quietly for years. The M.o.S. "blueprint" had envisaged the shrinkage of the number of units to four major airframe and two engine concerns.

Another topic was co-operation with the Corporations on civil aircraft design. This had been going on for years; but Mr. Bowyer stressed that it would be a good thing if more development flying could be done by R.A.F. Transport Command.

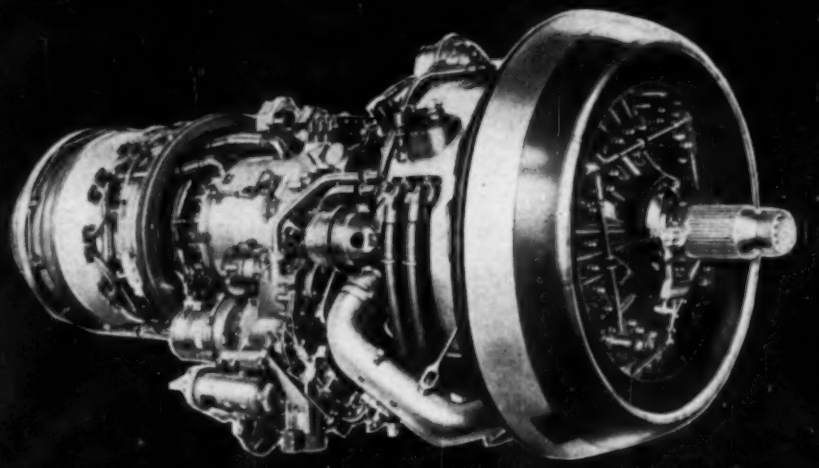
Though Government policies "have been known to change" it would be wise to assume, he commented, that the White Papers of 1957 and 1958 still meant what they said. They did not mean the end of Service requirements. There was a demand for a low-level strike reconnaissance aeroplane and a large freighter transport; there would be new helicopters and perhaps another M.R. aircraft. Combined with missile production, this meant that the Government would continue to be a large customer for many years.

The lecturer stressed the "overriding importance" of the export trade, which would diminish on the military aircraft side, though the influence of the Services on it should not diminish. On their intelligent placing of requirements a great deal could depend; he would like to see every Service requirement studied with an emphasis on its export possibilities. In the long term, the "$64,000 question" about exports was the extent to which civil air transport would develop throughout the world, and its corollary—the British share in the supply of hardware.

Finally, Mr. Bowyer had another word specially for his audience, whose future prospects depended on the future of the industry. He urged them, as technicians, to take an interest in commercial problems. He reminded them that despite the "thousands of millions of dollars" poured into the U.S. aero-engine industry, British jet engines—quoting American opinion—were still ahead. Finally, our breakthrough into the air transport field, after years in which we had designed no transport aircraft at all, was a tremendous achievement.

ROLLS-ROYCE

TYNE PROP-JETS



The Tyne is an advanced twin spool high compression engine in the 5,000 h.p. class and has been designed to give a very low specific fuel consumption. It is backed by the unique experience gained by Rolls-Royce in more than 6,000,000 hours operation of gas turbine engines in scheduled airline service at overhaul lives of up to 2,000 hours which have been achieved on Rolls-Royce Dart engines. The Tyne will power the Vickers Vanguards ordered by British European Airways and Trans-Canada Air Lines and the Canadair CL-44D long range transport developed from the Bristol Britannia for Canadian requirements.

ROLLS-ROYCE LIMITED, DERBY, ENGLAND

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FUTURE INTERNATIONAL AIDS TO AIR NAVIGATION

DECCA AND DECTRA DEMONSTRATION

The Ministry of Transport and Civil Aviation has decided to arrange a series of demonstration flights in a Comet jet airliner to show observers from a number of different countries the advantages of adopting the well-tried Decca and Dectra systems as an international standard aid to air navigation.

These demonstration flights will enable international observers to make their individual assessments of the two complementary systems prior to the Special Meeting of the International Civil Aviation Organization in February, 1959, to select a future short-range navigational aid for aircraft—a meeting that has evoked wide interest.

The demonstrations will show the following features of the Decca and Dectra systems:–

(1) The ease with which airways flying, climb, descent and holding patterns can be flown accurately.

(2) The precision and ease with which the pilot can report an aircraft's position.

(3) The ability to see the actual course of the aircraft plainly marked by a pen on a moving chart under the eyes of the pilot in the cockpit.

(4) The way in which the short-range (Decca) and long-range (Dectra) navigational aids are integrated to form a comprehensive system of air navigation using a unified airborne equipment.

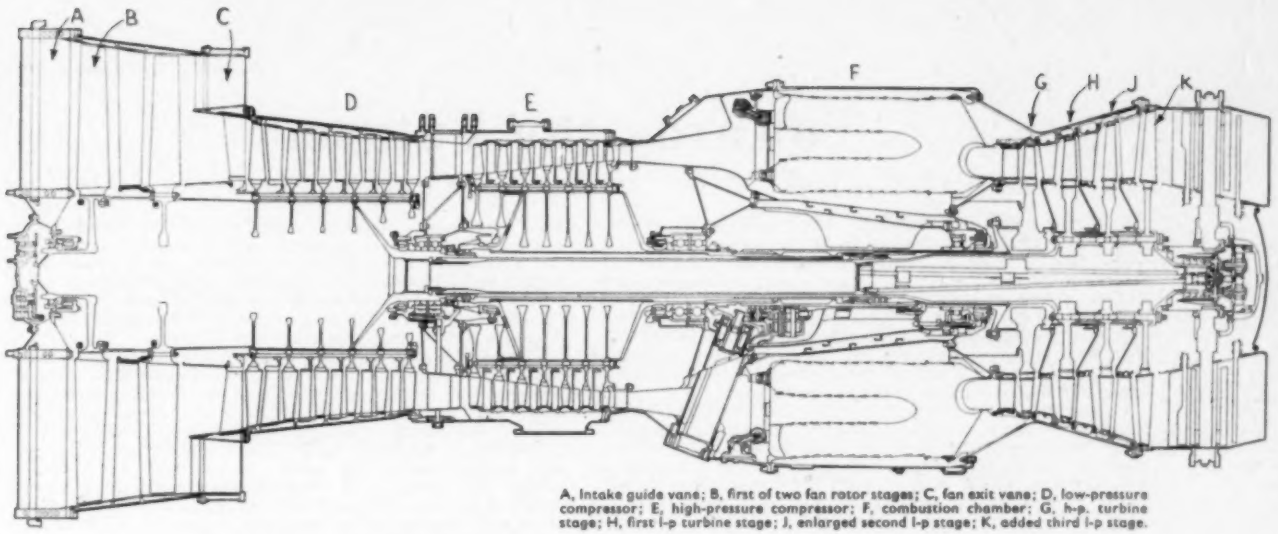
(5) Greater simplicity of navigation on the North Atlantic route.

Plans are in hand for a series of demonstration flights to be made in Europe in January, 1959. In February it is intended to conduct further demonstrations from bases in North America. Invitations will shortly be issued to aeronautical administrations and airlines to send observers to the demonstrations.

DECCA/DECTRA

THE NAVIGATION SYSTEM FOR THE JET AGE

THE DECCA NAVIGATOR COMPANY LIMITED LONDON



A, Intake guide vane; B, first of two fan rotor stages; C, fan exit vane; D, low-pressure compressor; E, high-pressure compressor; F, combustion chamber; G, h-p. turbine stage; H, first l-p turbine stage; J, enlarged second l-p stage; K, added third l-p stage.

Pratt and Whitney Turbofan

LARGELY owing to their excellent record as sound engineers, the Pratt and Whitney Aircraft Division of United Aircraft Corporation have achieved great success with their first generation of commercial turbojets. Today the JT3 series of J57 derivatives are in daily service in Boeing 707s; and the larger J75-derived JT4, which will power the bulk of the "big jets" at present on order, is flying in the second DC-8. Nevertheless, Pratt and Whitney have long been aware that these engines are inferior in specific consumption and specific weight to the Rolls-Royce Conway and certain other competing engines. In an attempt to maintain their leadership they have emulated Rolls-Royce and moved into the field of turbofans.

Preliminary notes on these engines were contained in our issue of June 6. The J57-size fan engine is the JT3D, and the first production version, the JT3D-1, can now be discussed in some detail. Compared with the JT3C-7 (the engine at present being delivered for the B.707-120 series) the D-1 is claimed to offer 13 per cent lower cruise s.f.c., 33 per cent greater static take-off thrust, 17 per cent greater sea-level climb thrust, 13 per cent more cruise thrust and to have 15 per cent lower specific weight and a noise level 10 db quieter. It is logical that Pratt and Whitney should have made it possible for conversion from JT3C-7 to JT3D-1 standard to be accomplished at an overhaul shop, and the entire centre portion of the engine is unaltered. The conversion kit includes two fan stages (which replace the first three stages of the low-pressure compressor spool) and their associated casings, two turbine stages (one of which replaces the existing, smaller third-stage wheel, and the other is an additional fourth stage) and their associated casings, water injection for the diffuser case, a strengthened low-spool shaft (to transmit the much greater torque) and a revised accessory gearbox.

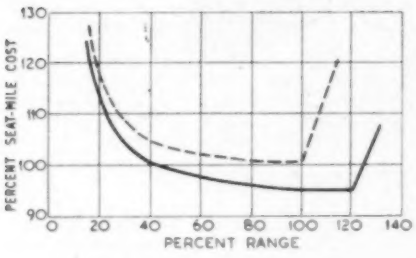
Compared with the C-7, the D-1 has "140 per cent more airflow, 26 per cent slower jet velocity." Extensive tunnel testing has led to a podded installation in which the fan air is discharged through lateral ducts carried well outboard of the nacelle at a point roughly half-way between the intake and the jet nozzle. Owing to the greater extraction of shaft-power there is less energy left in the main exhaust, and the "hot" nozzle is therefore of reduced diameter (and may not require a silencer). Nearly half the D-1's thrust is produced by the cold efflux from the fan.

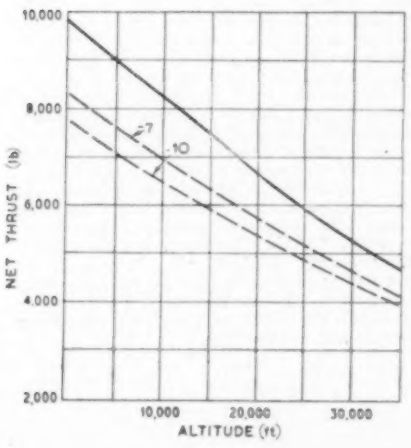
PRATT AND WHITNEY JT3D-1

Estimated dimensional and weight data; performance based on current running on the bench and in the Willgoos high-altitude laboratory.

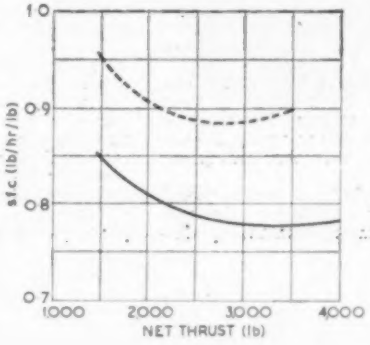
Overall length, in basic configuration shown in the section profile drawing, 140in; intake diameter, 51½in; fan casing outlet diameter, 48in; fan outlet inner diameter, 34in; maximum diameter across combustion chamber (max. diam. of original JT3C engine), 42in; dry weight, bare, probably about 4,360 lb; specific weight, based on max. sea-level rating of 16,000 lb, 0.272; peak total mass-flow, about 432 lb/sec.

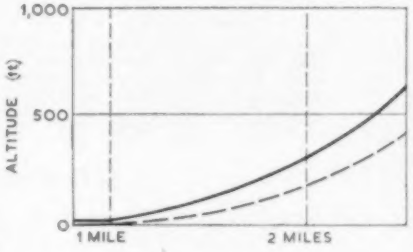
Maximum sea-level static thrust, 16,000 lb at 8,200 r.p.m.; maximum continuous dry rating at sea level, about 9,500 lb; maximum continuous cruise thrust at 35,000ft at Mach 0.82, 4,420 lb; corresponding fuel consumption, about 3,020 lb/hr.

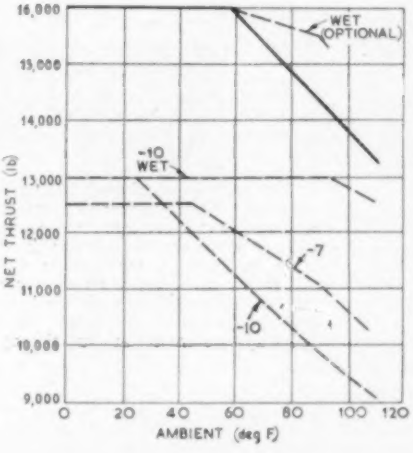




Estimated performance; anti-clockwise from the left: d.o.c. for a 250,000 lb aeroplane with JT3D-1 (full line) or JT3C-10 (broken line), the -10 being chosen owing to the 13,000 lb thrust needed; maximum continuous climb thrust, 300 kt i.a.s., standard day, for JT3D-1 (full line) and JT3C-7 and JT3C-10 (broken lines); below, estimated cruise performance, standard day, 35,000ft, M=0.82 or 472 kt t.a.s., for JT3D-1 (full line, with max. cruise as a point off to the right) and JT3C-7 (broken line); sea level static take-off thrust for JT3D-1 (full line) and JT3C-7 and JT3C-10 (broken line); right, take off of 250,000 lb aircraft with JT3D-1 (full line) and JT3C-10 (broken line), the horizontal ordinate being distance from start of run and the JT3D-1 resulting in 18 per cent shorter field length and 130ft more height at the 2½ mile point







Towards the Future

THIRD CANTOR LECTURE OF THE ROYAL SOCIETY OF ARTS

A WIDE review of present and future trends in the development of aircraft was given by Mr. Eric Mensforth, C.B.E., M.A., F.R.Ae.S., chairman of Westland Aircraft, Ltd., delivering the third and final Cantor lecture before the Royal Society of Arts on December 8. His paper, *The Future of the Aeroplane*, dealt in turn with the subjects of research, aerodynamics, propulsion, fuel, immediate development, military aircraft, civil aviation, structures and safety, terminal delays and short journeys, vertical take-off, cabin atmosphere control, instruments, sporting and private flight, and space travel.

Dealing with military aircraft, Mr. Mensforth said that the vital factor in the future was the development of nuclear explosives. These had increased by over one million times the destructive power of a single bomb and, being of moderate weight, could be delivered by a vehicle of great speed and range. Some bombers would continue to be manned so that they could patrol to avoid surprise attack and to permit their recall after a mission had begun.

The ultimate speed of these machines—fast (about Mach 2.5) or very fast (about Mach 10)—would depend on political choice within the technical possibilities of balancing fuel consumption against duration. The development of the intercontinental ballistic missile might be less concerned with fundamental design and more with the task of reducing preparation time for firing, increasing reliability and avoiding detection.

The terrible fact about any of these vehicles [the lecturer continued] is that a single bomb delivered without any great need for accuracy could do damage which, when multiplied only a few times, may be decisive. An aggressor could accept losses knowing that they need not be repeated if any of his force succeeds in its attack. The burden of defence is enormously increased; it has to be very close to 100 per cent effective or fail.

The United Kingdom official policy is to develop no new manned fighters; in the U.S.A. manned fighters of very advanced performance are perhaps foreshadowed by the research aircraft. Alternative defence is by the ground-to-air guided weapon: particularly when equipped with a nuclear warhead, such a weapon should be effective. Unfortunately it must rely on electronic devices which are vulnerable to similar interference and it is difficult to be optimistic about 100 per cent interception.

It is to be hoped that, with continuous vigorous development intended to stop any aggressor seizing a temporary advantage, a stalemate will continue. There remains the probability of local wars which may appear to present opportunities of turning the flank; whilst both sides threaten nuclear retaliation there may be manœuvring and fighting with conventional weapons.

Existing knowledge and experience is adequate to provide these in any form desired, e.g., fast low ground-attack, submarine search and strike. There will be a certain need for fast long-range transport aircraft . . . (which) may well be developed simultaneously with new civil airliners.

Turning to the subject of civil aviation, the lecturer emphasized that civil aviation basically sold speed. To do this it must not waste a disproportionate amount of time at terminals, and time savings here could be as important as those resulting from aerodynamic advances. There might also be a clash between flying speed and the average service expected by the passenger.

A basic feature of the economics of civil aircraft operation was that, as range increased, it became profitable to fly at progressively higher altitudes (where drag for a given speed decreased) and at higher speeds (with a corresponding increase in jet propulsion efficiency). The crux of tomorrow's problem was the use of fuel to the best advantage in climb, cruise and let-down.

It appeared that the best profit margin to the operator would occur immediately with the following aircraft, assuming similar sizes:— With no runway restriction on take-off, the turbojet cruising at about 45,000ft and 600 m.p.h. over a range from 1,000 to 5,000 miles; with a runway restriction of, say, 3,000ft on take-off, the turboprop aircraft cruising at some 35,000ft and 450 m.p.h. over similar ranges. The validity of this conclusion could be affected by timing. The Viscount/Dart combination arrived exactly at the time when new short-range and medium-range airliners were wanted, but the long-range turboprop had overlapped with the turbojet machines.

Supersonic airliners already planned should achieve operating costs comparable to present-day levels. The choice of cruising speed was open, but the least would be 800 m.p.h. or Mach 1.2. Such an aircraft would be sensitive to changes in cruising conditions and would be capable of little development. Its wing would have an aspect ratio of about 3 with 50-60 deg sweep-back.

The next speed would be about 1,200 m.p.h., when an economic cruising performance would be obtained with a very slender wing planform of aspect-ratio unity and 70-80 deg sweep-back. This would probably be an all-wing aircraft of 7,000-8,000 sq ft area, and this configuration would bring low-speed difficulties which we could expect to overcome by novel devices such as jet deflection and perhaps variable-wing geometry.

The next speed would be about 2,000 m.p.h., or Mach 3, where the turbojet operated close to its optimum. Development of such an aircraft would be a project of great magnitude.

The development of faster aircraft, of conventional shape and structure, would probably continue to bring cheaper and cheaper flying. But the economy of the "faster and higher" philosophy would reach an optimum stage, beyond which the desire for speed might have to be paid for.

Higher cruising speeds were even now contemplated. A recent Bristol study concerned a powerplant combining turbojets for take-off and landing with ramjets for high-speed cruising, both buried within the wing and using a common supersonic air intake. This flexible arrangement gave the possibility of a payload 50 per cent greater than that of a turbojet when operating at 3,500 miles range and Mach 3.

The U.S. Navaho unmanned, winged, nuclear delivery vehicle design study was propelled by 48in twin ramjets, with initial launching by rockets of about 400,000 lb thrust to give a Mach 3 performance at a range of 6,000 miles. As an indication of the figures involved in such development, the estimated cost was $620 million.

Still faster travel might be achieved by initial acceleration to a great speed and height and then gliding to the destination—a "boost glide" technique with flight durations of, say, one hour for distances of about 10,000 miles.

HOW TO TAP THE AIR-FREIGHT MARKET

THE subject chosen by Mr. E. D. Keen, chief designer to Armstrong Whitworth Aircraft, for his lecture to the Birmingham branch of the R.Ae.S. on December 4, was *Freighters—A General Survey*.

The lecturer opened his address by declaring that "Freighter aircraft designed for the civil market are practically non-existent." Because freighters were less glamorous, this type seemed to have been neglected by operators and manufacturers alike. It was also equally true that those whose responsibility it was to send goods from factory to market looked no farther than the quoted air-freight rates and dismissed them as being more expensive than those for surface transport, without considering other advantages.

The speaker reminded his audience that air-freight rates were only one of many factors to be considered in assessing the value of air freight: lower insurance, reduced packaging, less handling, less risk of damage and pilfering, lower interest on capital, reduced inventories and less paper work: all these were significant factors that favoured the use of air transport.

Mr. Keen then examined the characteristics of freight aircraft and the problems of freight handling. "Whereas," he said, "passenger cabins are in general long thin tubes, aircraft specifically designed for freight have short fat ones." The main difference between passenger and freighter aircraft lay in the cross-sectional area arising from the greater fuselage width always demanded. As a result freight aircraft were in a less glamorous class of aerial vehicle than their passenger counterparts: their shorter, fatter and less streamlined fuselages would make them slower. To provide clear freight holds they would have to be high-wing aeroplanes with either long stalky undercarriages or bulges in the side of the fuselage. The necessity for low floor height from the ground made the shape of the fuselage depart from the ideal circular section, while the freight floor had to cater for higher loadings.

The loading rate had a direct bearing on aircraft utilization rates—utilization on a 500-mile sector could be doubled by increasing the loading rate from 250 to 2,000 lb per minute. The first of these figures corresponded to the present rate achieved on converted civil aircraft with side loading without special aids apart from fork-lift trucks. The Cargon system used by S.A.F.E. in New Zealand could achieve 2,500 lb/min. But air carriers seemed to be disinterested in such developments, largely because they were difficult to apply to the present unsuitable aircraft.

The speaker concluded his paper by describing the design philosophy of the Argosy and its variations.

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...THE LIGHTNING IS INCOMPARABLE

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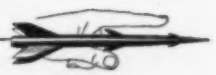

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With Viscounts in the Orient

A HONG KONG AIRWAYS PILOT'S IMPRESSIONS

BY NEVILLE HALL

Japan's famous Mount Fuji seen from one of H.K.A.'s Viscounts

ON February 10, 1957, the first Viscount in the Orient touched down at Kai Tak—Hong Kong's Airport. Since then the characteristic whine of the Rolls-Royce Dart has become a familiar sound on the Hong Kong Airways routes, from Korea and Japan to the Philippines.

Formed in 1947, Hong Kong Airways began its operations by flying to Shanghai. Soon after it added Canton and Manila to its routes, and later Taipei. But great events were shaking the world, and the Red armies were sweeping through China. In 1949 the bamboo curtain had fallen and the vast Chinese mainland was closed to the air transport of the west. Hong Kong Airways' DC-3 fleet was sold and, until the first Viscount landed in 1957, the airline was maintained by using chartered aircraft on its thrice weekly Hong Kong/Taipei service.

In 1956 B.O.A.C. joined forces with Jardine Matheson and Co., the vast trading company famous throughout the Far East, and Hong Kong Airways was re-born. In February 1957 the airline began its scheduled services to Korea. The second Viscount arrived in March, and in that same month services began to Manila. These services were gradually built up to include Taipei and Tokyo.

In Hong Kong Airways we operate with two-pilot crews. The routes we fly could be described as interesting and varied, ranging as they do from the icy sub-zero weather of the Korean winter to the soggy nineties of Manila.

The mountain-ringed airport of Kai Tak, with its famed approaches, soon becomes as familiar as the Epsom stack and London Airport. But familiarity never breeds contempt, and Kai Tak is always treated with the greatest respect, although it is surprising how one does get used to it. In actual fact the airfield has a very good safety record, and the airport controllers are always very efficient and helpful. And now there is the new runway, which points its 8,340 feet straight towards the Eastern Gap and the open sea.

Our Viscount 760s are equipped with twin Marconi A.D.F., Murphy D.M.E., and the APN-9 Loran set. We also have twin H.F. communication sets and main and stand-by V.H.F. systems. All these radio aids are controlled by either of the pilots without having to leave his seat. The Loran is placed between the seats, and becomes a step when not in use. When needed, it swivels up, allowing either pilot to obtain a fix. On the short hauls—Hong Kong to Manila and Hong Kong to Taipei—the navigation is based on the A.D.F.s and D.M.E., but on the sea crossings from Formosa to Japan and Korea the Loran is invaluable.

Accurate navigation is absolutely essential on the routes we fly, by reason of (among other things) the extremely touchy political and military situation in this part of the world. Apart from the usual reporting points, we are plagued with A.D.I.Z.s (pronounced A.D.I.ZEE)—air defence interception zones. A navigation error of more than ten miles from the centre of the airway, or an error in E.T.A. of more than five minutes, can cause fighter aircraft to be scrambled. The U.S.A.F. keeps close radar watch over this area, and errors cause a great deal of fuss, bother and explaining to be done later. And, of course, it is considered advisable to maintain a reasonable distance from the coastline of Red China and the Korean Border. The poor meteorological forecasting of upper winds in this area adds to the difficulties, and on the critical parts of the route a fix every half-hour is usually obtained. At the beginning of our operations we worked on a system of pre-computed Loran position lines, but with practice it was found that a fix could be obtained swiftly and easily on the APN-9.

From the weather point of view, the main things that affect us are the typhoons which occur between June and November, and the strong westerlies over Japan and East China Sea during the winter months—the sub-tropical jetstream.

On September 22, 1957, Typhoon Gloria passed about 30 miles to the south-west of the Colony. Winds of hurricane strength were recorded, with a peak gust of 101 m.p.h. One of Hong Kong Airways' Viscounts was in Tainan, Southern Formosa, waiting for the typhoon to pass. The other was "safely" in its hangar—until one tremendous gust tore the steel hangar door from its hinges so that it fell inwards, striking the nose of the Viscount; then, luckily, it was hurled out on to the apron. The damage to the aircraft—though fortunately less severe than at first feared—caused several services to be withdrawn. In the first 18 months of Viscount operation this was the only delay which, however unfairly, could have been put down to aircraft unserviceability. During this period we did not have to feather an engine; and out of 1,260 scheduled flights only nine were delayed or cancelled, and Typhoon Gloria was the cause in most of these cases. Some mathematically minded person has worked this out to a figure of 99.286 per cent regularity.

On our longest run, Hong Kong to Tokyo, there was not one delayed arrival at Haneda in 214 scheduled flights. And all this with only two aircraft. On Fridays we have three arrivals and two departures at Taipei alone, and it is not surprising that many people think that we operate far more aircraft than we actually have.

The typhoons can be awkward, but they are usually very well plotted, and we are kept informed during flight of their latest position, speed and direction. They are fairly local in effect, and sometimes very useful tail-winds in both directions can be obtained by a little careful flight-planning around them. The strong upper-level westerlies are a different story. At the beginning of November, with the decreasing temperatures, these strong winds sink to lower altitudes. This gives rise to a complicated problem at 16,000ft on the 1,186 n.m. leg from Tokyo to Taipei, where we are often faced with a 60 kt headwind component. At the same time, with the decreased temperature, the fuel flows increase from a summer figure of 2,650 lb/hr to 3,000 lb/hr or more. The decreasing wind-strengths for the lower altitudes have to be very carefully matched against the increasing fuel flows. We have some useful graphs in our flight-planning book. In practice, by the time we have reached Kagoshima, which is almost 500 miles from Tokyo and the last ground fix before Formosa, we have calculated our ground miles per lb of fuel, selected the best altitude, and obtained the latest weather and forecasts for Taipei, Tainan and Okinawa. The most useful altitude is the closest that one can get to the theoretical optimum, allowing for the increasing wind-strengths with height. Before take-off a height-to-fly is selected, based on the forecast winds. This is calculated, again using the graphs, by working a quick comparison.

Unfortunately, the forecast winds are seldom correct, and it is essential to obtain accurate wind and ground speeds as soon as possible. On March 28 this year a service took off from Tokyo with a forecast wind given as 260 deg, 60 kt, at 18,000ft. It did not take long to discover that something was very wrong, and it was soon found that the wind was in fact 280 deg, 135 kt. It is under these conditions that one misses the flexibility of the piston-engine types: in the turboprops one cannot duck under the head-winds. It is a problem that B.O.A.C. found very trying with their Comet operations on the Tokyo-Okinawa run. And the big jets are going to have a lot of trouble with these extremely strong upper-level winds.

By the time we have reached Kagoshima we can make a decision as to whether a fuelling stop at Okinawa is required: but familiarity with the route, and a careful selection of altitude, seldom makes a stop necessary. A very close Loran check, however, has to be maintained across the sea, to ensure that one does not run into any jetstreams. These streams are very prevalent in the Japan and East China Sea areas, and are almost never forecast. There is one which is semi-permanent at one period of the year, varying in its velocity. This is the sub-tropical jetstream, a belt of strong winds often 700 n.m. wide. The level of strongest winds is about 40,000ft, and, unlike the other jetstreams, this one is not generally associated with a surface front. It appears in the area of Shanghai, curves past the northern tip of Formosa to Okinawa, then up towards Tokyo and beyond. Winds of 80 kt have been reported as low as 14,000ft. Other jetstreams are found in the Korean area, but are of the normal temperate-zone types and the strong stream is usually only 100-130 miles across. These, too, are usually from a westerly direction, but exceptional cases do occur.

Hong Kong Airways' two Viscounts photographed on one of the rare occasions when they are both at Kai Tak, Hong Kong, at the same time

With Viscounts in the Orient . . .

On one occasion we left Korea after obtaining a fix from overhead Kunsan. With the extremely low temperatures over Korea in winter, we climbed straight up to 24,000ft and were above the overcast. My first Loran fix was unbelievable, and the second seemed even worse. Then the cloud-cover ceased, and a visual fix on the Island of Cheju-Do confirmed that, having allowed ten degrees of drift for the forecast wind, we had still drifted 50 miles off-course in a run of 160. Which is some wind! As one captain said, after a similar experience, "We had so much drift I had to go back into the passenger cabin and look out of one of those wide panoramic side windows to see where we were going."

Of course, when we are going to Tokyo these winds are very helpful, and we look for them. As the temperature falls off we make a step climb to maintain optimum altitude and often reach 26-28,000ft by the time we begin let-down for Tokyo. At that height, in the full flood of the stream, the check-points fairly flash past. Hong Kong Airways broke the record on the Hong Kong to Tokyo run and held it until the Britannia finally managed to wrest it from us. We still hold records from Hong Kong to Taipei, Hong Kong to Okinawa, and Taipei to Tokyo.

Going to Hong Kong, with China closed to us, means that our diversionary airfield is Tainan in Southern Formosa. This is about one hour and twenty minutes' flying time away and its annual weather record is extremely good.

Tokyo and Kimpo in Korea have G.C.A., and Taipei has I.L.S. With Hong Kong's new airfield, we are in the process of getting all the most modern radio aids, including VOR. With the Viscount runway lengths do not affect us, and we find most airfields in the Far East quite adequate. The main troubles are poor surfaces, while some airfields insist on their placing taxying lights on the top of poles, which adds an extra hazard for our low-clearance propellers.

Weather and other conditions at Tokyo (a very fair imitation of those of London Airport), and the complicated airways systems of arrivals and departures, give us ample opportunity to keep in practice with airways flying and let-down procedures.

Flying the routes that we do, we find that we have a lot of contact with the U.S.A.F. In all our dealings with them they have been most helpful and friendly. On the ground our aircraft always cause a lot of interest and come in for a great deal of praise. As they say, "Gee, this Vizzcount sure is a nice ship."

NEW M.o.S. POST

IT is announced that one of the Deputy Directors of R.A.E. Farnborough, Mr. W. H. Stephens, M.Sc., F.R.Ae.S., has been appointed to the newly created Ministry of Supply post of Director-General, Ballistic Missiles. He is to be succeeded at Farnborough by Mr. S. F. Follett, the Director-General, M.o.S. Staff, British Joint Services Mission, Washington; and the U.S.A. post is being taken over by Mr. L. T. D. Williams. The Ministry further announces the appointment of Mr. J. H. Phillips as Director, Guided Weapons (Techniques). All these appointments are due to take effect early next year.

Before becoming one of the two Deputy Directors at Farnborough, Mr. Stephens was from 1954 to 1956 Head of the R.A.E. Guided Weapons Department. He has had considerable experience in the ballistic-missile field, having been engaged in 1938-39 on rocket research at the Ballistic Division, Woolwich, and appointed Superintendent of the Assessment Division, Guided Weapons Dept., R.A.E., in 1947.

LONG-RANGE TANK distinguishes Westland Widgeon G-APPR, air-freighted this week to the Persian Gulf in company with another Widgeon, G-APPS. Both have been ordered by Bristow Helicopters, Ltd., who will operate them under charter to the Iranian Oil Exploration and Producing Co. for work on pipeline construction. Bristow already have two Widgeons and two Whirlwinds on similar duties

MAGISTERS FOR AUSTRIA

LATE last month an order for six Fouga Magister twin-jet trainers was placed by the Austrian Air Force. Austria thus becomes the seventh nation to use this French aircraft, the others being France, Western Germany, Belgium, Holland, Finland and Israel. Bulk production is at present in hand at the Potez-Air Fouga plant at Toulouse-Blagnac and by Flugzeug Union-Süd (Heinkel at Speyer and Messerschmitt at Augsberg). Licence-production is being established in Finland and Israel. The navalized variant is the CM.175 Esquif, produced for the French Navy. Total output from Toulouse is now about 200.

PAPERS ON ICE

WIDE interest was created by the aircraft ice protection conference sponsored by D. Napier and Son, Ltd., and held at that company's flight-development establishment at Luton Airport last summer. The five major papers read before this conference, together with the ensuing discussion, have now been published in book form; it is available from D. Napier and Son, Ltd. (P.O. Box 26, Luton Airport, Beds.). The company were very gratified at the success of this conference and hope to sponsor another.

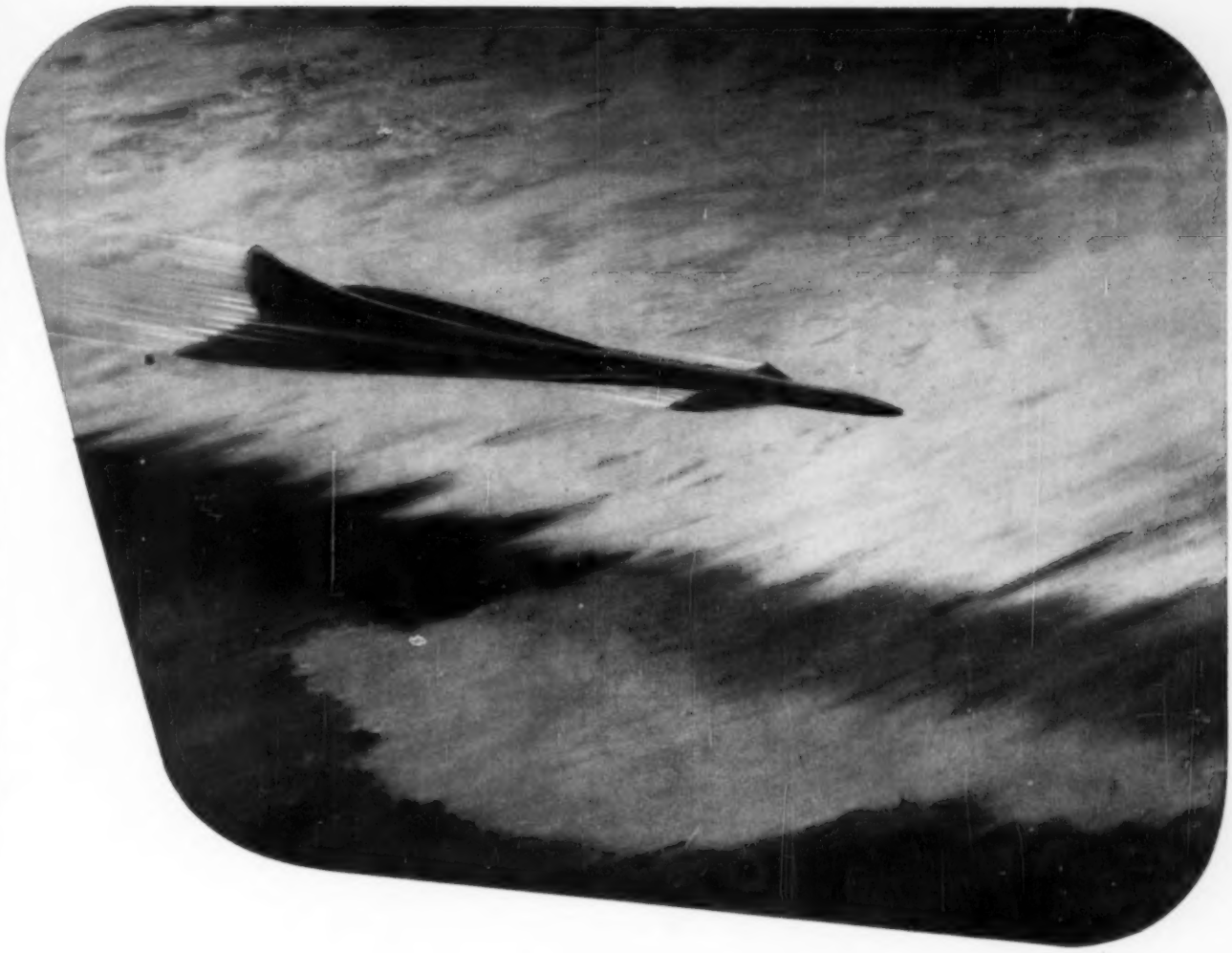
AGRICULTURAL ACCESSORIES

REVISED brochures have been produced by Transland Aircraft, Torrance Airport, California, to describe the company's crop-dusting and spraying equipment. These products, most of which are approved for installation in Stearman (Boeing 75 series) aircraft, include 165-gal and 186-gal aluminium glass-fibre-lined dust and liquid hoppers, agitator gate, spreader, Pickell pumps, dump and pressure regulator valves, plumbing, trailing-edge booms and nozzles, pressure gauge, pilot controls and Sellers Swathmaster and Transland dusting and spraying kits.

R.34 MEMORIAL: GUILD'S PROTEST

THE storm over the design of the memorial which it is proposed to erect at London Airport to commemorate the double crossing of the Atlantic by the airship R.34 in 1919 has not abated. The Guild of Air Pilots and Air Navigators last week issued a statement saying that, while they applauded the Air League's initiative in proposing to erect the memorial, it was their view that its form "is not appropriate to perpetuate the memory of a great aeronautical achievement and the men who contributed to its accomplishment."

The Freemen of the Guild had submitted this opinion to their Court with a request that it be communicated to the Air League, the Minister of Transport and Civil Aviation, and others interested. In announcing their action they express the hope that other aeronautical organizations will support their view and take appropriate action.



Flying above the sub-tropical jet stream

This is an artist's impression of flight on the direct South Africa-Australia route during the next decade or so. It illustrates the aircraft at 25,000 feet above the sub-tropical jet stream, in latitude 35°S over the southern tip of Western Australia.

The mean axis of the southern sub-tropical jet stream shown above is about 40,000 feet, and like its northern counterpart, is an east-flowing band about 500 miles across, with speeds varying from 50 to 100 knots, and at times reaching 250 knots.

Associated with thermal boundaries between air masses, the jet stream is often revealed by characteristic cloud formations at the base of the stratosphere — and operators of the powerful multi-jet airliners of the future will find these jet streams an important factor in flight planning.

Flights at such altitudes, involving supersonic speeds and great thermal extremes, will demand the special petroleum products which are now being developed by Esso Research.

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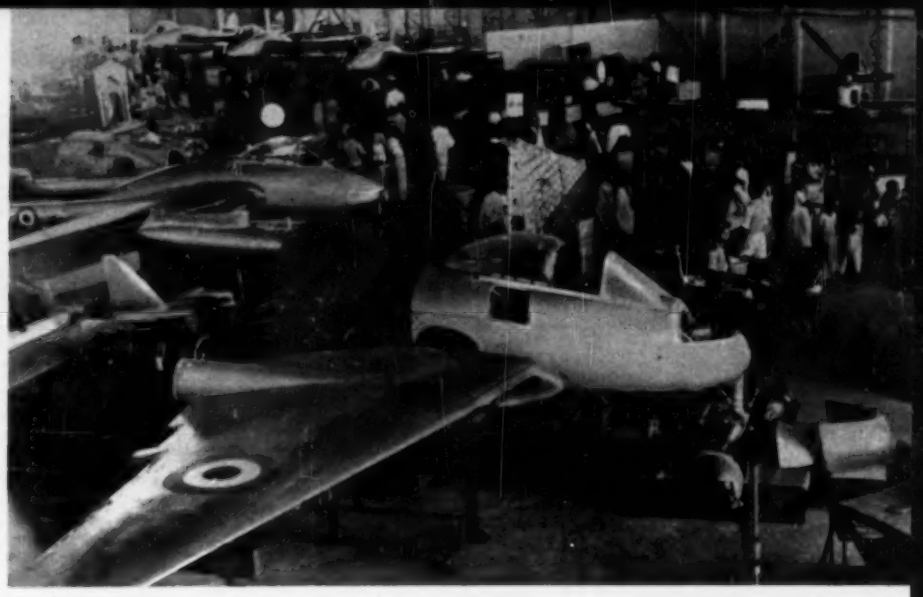
Indian Industry—1

VISITING India in order to cover the recent I.A.T.A. Conference in New Delhi and to see the Indian Air Force at work (the subject of subsequent articles), a member of "Flight" staff also took the opportunity of discussing production and design at India's national aircraft factory and of flying one of its products

By ALASTAIR PUGH



Vampire Mk 52 and HT-2 production at H.A.L. recalls the Hatfield and Chester lines with Vampires and Chipmunks under construction; but crowds like those in the photograph never attended de Havilland open days

AROUND HINDUSTAN AIRCRAFT

BANGALORE, in India's Mysore province, is the home of the nation's only aircraft manufacturer: Hindustan Aircraft (Private), Ltd. The Hindustan company occupies at least 1,100 acres and is still rapidly expanding, although not all its output is devoted to the production and repair of aircraft. Rail coaches (including a new Integral coach of German design) are being made in quantity, bus bodies and prefabricated body kits were manufactured until recently, and radio and radar vehicles are a new interest.

Still only 18 years old, H.A.L. is destined to play an important part in India's plans for widespread industrialization, and as such receives Government contracts for certain projects. Even so, this nationalized concern—without peer (and incidentally without competition) in India or even in Southern Asia—has an independent identity and is undertaking the manufacture not only of bombers, fighters and trainers, but also of aircraft for which there is a popular "private sector" (to use the Indian expression) demand. The little Pushpak (briefly described in *Flight* for October 17) is the first example; its future is not yet decided, but it will probably go into production if orders for about 100 can be assured. Present indications seem to be that they can.

Briefly, H.A.L. was formed in 1940 for wartime overhaul of DC-3s and C-47s. A few aircraft (Curtiss Hawks and Harlow trainers) were built and one aircraft was designed and manufactured. This was a troop-carrying glider with ten seats. But progress in an entirely new field for India was rather slow and the company's main effort was devoted to the overhaul of Liberators, Fortresses, Mitchells, Catalinas and, particularly, Dakotas and Pratt and Whitney engines; the last-named at a peak rate of 300-400 a month.

This experience served H.A.L. in very good stead and they became adept at a task that was to prove their salvation in peacetime. There were plenty of potential operators just after the war who wanted DC-3s, and plenty of DC-3s that could be reconditioned from war-surplus stocks. This rather bald statement really conceals an intriguing story: a great many aircraft and a lot of equipment was junked—broken up or just abandoned—in India after the war, and H.A.L. has rescued a good deal of useful material from the wreckage; not only for DC-3s but Liberators and other types as well. The village bazaars are still conned for instruments or propellers which, after complete overhaul and inspection in the factory, can provide an urgently needed spare quickly and without requiring expenditure of foreign—and particularly dollar—exchange.

If there is an inference of parsimony here it is wholly in line with India's current intense struggle for a better standard of living. There is little money to spare and the end result in these cases justifies a certain amount of improvization. Hence the vigorous expansion that Hindustan are undertaking—more than half-a-million square feet of floor space is being added—is part of the controlled expansion of the general economy, and what is happening at Hindustan may be regarded as a yardstick of the importance of aviation to India.

The basis of H.A.L.'s growth has been a massive overhaul business and the manufacture of certain types of aircraft under licence. DC-3s are overhauled and converted for many airlines and for many purposes; for instance, first-class navigation and signals-training flying classrooms for the Indian Air Force, V.I.P. interiors and even a pressurized cabin cell for a former Deputy Prime Minister. This is part of the day's work. A branch factory was established at Barrackpore near Calcutta in 1952 for the overhaul of DC-3s and it will soon be devoted to this work entirely. Activities include repair of radio, instruments and propellers; the organization is approved by the American Civil Aeronautics Administration and is a Douglas-authorized service centre and a repair and service agent for de Havilland. H.A.L., incidentally, is also a member of the S.B.A.C.

Another branch of the firm's activity is the responsibility for service and maintenance at certain I.A.F. units; this makes particularly good sense at such stations as Jodhpur, where basic flying training is carried out on Hindustan HT-2s. This aircraft is the first indigenous design to be put into production in India or, indeed, in all of South-East Asia. It was conceived in 1948, first flew in 1951 and is now the standard *ab-initio* trainer for the I.A.F. and the Indian Navy, and is used also by the civil aviation training establishments for basic flying training. It is hoped that a number of HT-2s can be exported (some have already been delivered to civil aviation authorities in India) and the type is in production at Bangalore.

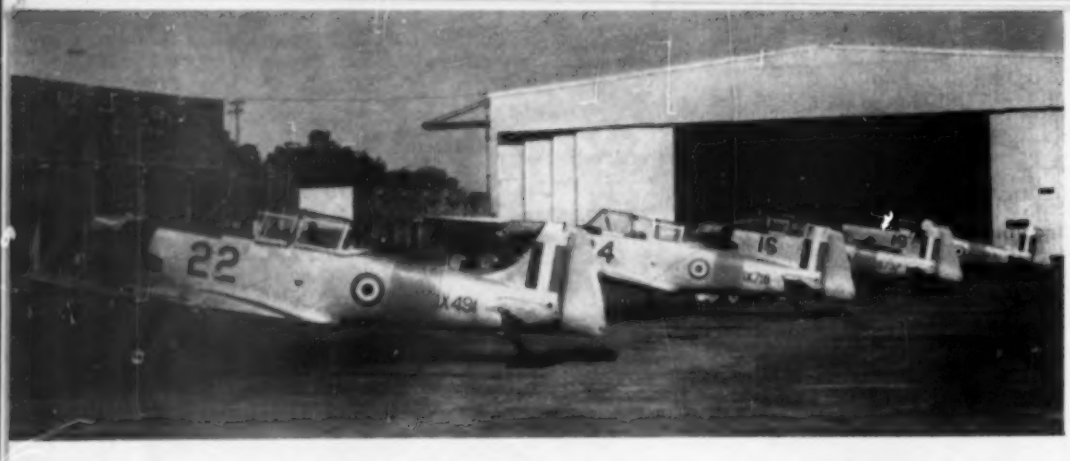
Current activities at the South Indian factory are the manufacture of Vampires, both Mk 52 (Mk 5Bs) and T. Mk 55s (T11s), development work on the Pushpak and a new light aero engine, preparation for manufacture of the Gnat and its Orpheus engine and overhaul of Canberras and Avons. In addition to this programme, the design department, under Dr. V. M. Ghatage, has been very active and designs have been produced for a 10-passenger high wing transport, the HCP-25 "two-ton truck," an all-through jet trainer and an advanced fighter.

Although production of Vampires is soon to taper-off, construction of T. Mk 55s is currently the main preoccupation of the Bangalore workshops. At the time of our visit last month, a day fighter, bearing the inscription *Finale*, was passing down the line; it is the last of a very considerable number of this type to be built at Bangalore. But production of a substantial batch of Vampire trainers continues. Goblin engines are supplied by D.H.

With certain exceptions resulting from Bangalore's balmy climate (the assembly hangars, for example, are constructed with doors at one end only) the Hindustan scene is reminiscent of the de Havilland factories a few years ago. There are the same familiar wing jigs with wing skins in their grey-green primer undercoats; airframes, air-entry ducts a-gape, awaiting installation of the Goblin engines; the same green-painted firewalls criss-crossed with control runs and fuel pipes; the same jobs being done in the cockpit, on the undercarriage or in the cannon bay. Only the workpeople are different; and perhaps not so very different at that.

The similarity is heightened by seeing many of the same tools at Bangalore as at Hatfield, the same Hufford stretcher presses, with their powerful swinging jaws; stretch forming tools for profiling cowling panels, rubber presses squeezing depth into boom fairings, Farnham rolls forming leading edges on wing panels, and Vampire canopies being moulded in just the way that they used to be made at Hatfield. Vampire production has been tackled on a big scale, in an entirely professional manner, and performance of the task has been another stepping stone in H.A.L.'s progress towards design autonomy.

The relationship between H.A.L. and the Indian Air Force is a close one, and it is worth examining in a little detail. Prior to



The HT-2s lined up here are in service with the Indian Air Force at Jodhpur. Their servicing remains the responsibility of Hindustan

"Flight" photograph

AROUND HINDUSTAN AIRCRAFT . . .

construction of the Pushpak—as yet a minor project—almost all of H.A.L.'s production facility was devoted to the needs of the Indian Air Force, and only overhaul and repair work involved civil contracts. H.A.L. consequently has a unique relationship with its biggest customer, for whom in the design of new aircraft types it can cater exclusively.

The present period is an important one in H.A.L.'s history, because it is now becoming actively engaged in the design of new aircraft for the I.A.F. The growing-up process is a logical one, but its rate must always be tempered both by the need to progress in relatively modest steps and the limited funds that are available for new aircraft projects. The two conditions are really inter-related and the way in which H.A.L. is pushing ahead now may be interpreted as its transition from commercial adolescence to industrial adulthood.

Following a decision to introduce the Gnat as the standard day fighter for the I.A.F., and close co-operation between the manufacturers and the Policy and Plans section of the I.A.F., it has been agreed that the first Gnats will be bought directly from Folland, some sets will be assembled in India and then both Gnat airframes and Bristol Orpheus engines (to complete the full order) will be built at Hindustan. The next step is for H.A.L. both to design and build an indigenous jet trainer and a fighter of higher performance than the Gnat, and to make use of Gnat and Orpheus development, production and operational experience in the new aircraft.

A number of Gnats already delivered to India are being evaluated at the Aircraft and Armament Testing Unit at Kanpur. An extremely searching examination is being conducted and an extended operational and tropical trial was completed this summer. The results were passed on to Boscombe Down (where service acceptance trials are undertaken) and also, of course, to Folland. The Indian Air Force Gnats may differ slightly from the standard recommended by Boscombe Down. For example, the I.A.F. prefer a different gear ratio on the longitudinal control and will probably not have non-linear gearing in the circuit.

Although a cockpit cold-air modification remains to be completed, and the design has not (or had not in November) yet been "frozen," the design standard for the start of manufacture in India is generally agreed and structural components of the Gnat are already on their way to Hindustan. The factory will also be supplied with one of each detail component to assist tooling, and some 250,000 drawings.

Very close collaboration is maintained with the R.A.F. and with Folland (the work in this connection of the Indian test pilot, S/L. Das, is widely known, but through the Office of the High Commission of India, and through Folland representatives, there is liaison at all levels). This is the first occasion on which the Indian Air Force has taken so close an interest in the development of an aircraft type before even the first deliveries have been made, and it is doing so in order to gain experience for the time when similar development and evaluation will be done on the products of the home industry. Much has been learned: acclimatization during trials extended through the monsoon rains and summer heat revealed the need for tropical modification additional to that shown to be necessary by an earlier and shorter R.A.F. trial in Aden.

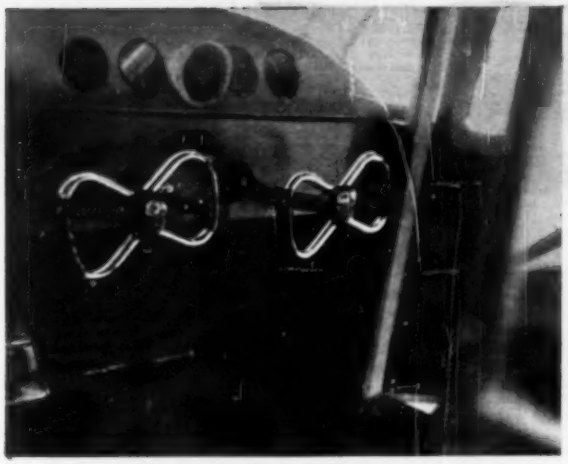
The first set of Folland jigs is now installed at Bangalore, and duplicate sets erected by H.A.L.—of the same robust tubular design—are going up alongside them. Orpheus production appears to be a little farther behind. The company are reluctant to stockpile engines awaiting airframes in which to fit them and, in conjunction with Bristol Aero-Engines, they are preparing a new factory of extremely modern design for the production of the Orpheus and overhaul of Rolls-Royce Avons. A feature of these buildings is that the roof-span is interrupted to form a kind of quadrangle in the centre of each block; the idea is to provide really adequate cross-ventilation in the hot weather.

Some 500 lakhs of rupees (£3,800,000) are being invested in this new factory; enough to cause some lip-biting anxiety that more may have been bitten off than can easily be digested. Yet there seems to be little virtue in not planning boldly; and Mr. P. M. Reddy, Hindustan's deputy general manager, argues that if industrial expansion is going to continue then floor space must be provided. The Orpheus is intended not only as the powerplant for the Gnat but probably for other aircraft to follow, and it is clearly the Indian Government's intention to see that there will be no bottleneck in the supply of engines.

Because the Gnat is likely to have a profound influence on Indian military aviation, it is worth examining some of the reasons for its choice. It was bought not because India believes wholeheartedly in the light fighter concept *per se*, but because a light fighter is very much less expensive than a conventional one. The price of current aeronautical development is causing the country great concern and is a potent argument in favour of developing the home industry in the manner that is actually being followed. The supply of raw materials to the factory has been greatly improved—previously this had been a serious problem—and the entire manufacture of Gnat airframes and Orpheus engines will be possible within the confines of the one factory. Proprietary components will still have to be imported for some while, but electronic equipment can now be tackled by the home industry. Eventually, equipment manufacture will be undertaken as well; and hydraulics might be a first step in this direction. As an example in a small way, the HT-2 undercarriage is entirely of Hindustan design.

Indian Air Force requirements are keeping the design staff very busy. It is an I.A.F. intention to introduce an all-through jet trainer to fill a rôle similar to that of the Jet Provost in R.A.F. service. It may well be that the first jet trainers will be purchased from abroad, but eventually an Indian product will be used, and Hindustan are busily engaged in the design. At the time of my visit, Dr. Ghatage (who, incidentally, studied under Prandtl at

Seen here just after it was completed, the prototype Pushpak has attracted considerable interest among potential private owners. The moulded windscreen is manufactured in the H.A.L. canopy shop



The Pushpak's dual controls are kept deliberately simple. Prototype instruments are of American origin, overhauled and with re-calibrated dials. There is side-by-side seating for two "Flight" photograph

Göttingen University) was preparing schemes for both side-by-side and tandem arrangements; the controversy rages as hotly in India as in Europe or America. Vision in formation flying, and for the instructor when landing, and c.g. changes, are design-cases that must be met, but the final decision will generally depend upon current views on instructor-pupil psychology. To a half-serious suggestion that a staggered-seat layout should be adopted, Dr. Ghatage replied that it had, in fact, been investigated and "wasn't a bad compromise." If the aeronautical engineer has a preference it is likely to be for a tandem arrangement and a slim fuselage; that way a better performance can be obtained from a given power unit. Which engine will be chosen in the case of the Hindustan Trainer (the provisional designation of which is HJT-16) is as yet undecided, but Armstrong Siddeley Viper, Turboméca and Rolls-Royce RB.145 units have all been considered.

It has been reported that under the direction of Dr. Kurt Tank, the German engineer responsible for the formidable Fw190, Hindustan are developing a fighter. It is interesting to speculate on the form that the first fighter to be born in the tropics might take, particularly since many of the factors that must govern the design are known. It is not practical, for example, for India to attempt to compete with the United States, England or Russia in a race for ultimate performance; but higher-thrust versions of the Orpheus with reheat, such as the BOr. 12, could be manufactured in India under an extension of the licence agreement (Hindustan know-how on the Orpheus would appear to make this a logical, although not obligatory, choice). The combined thrust of two reheat Orpheus could certainly give the new fighter a performance substantially better than that of anything at present flying in India.

Preparation for more advanced designs is also continuing in other directions as well: at Bangalore, for instance, H.A.L. are extending their runway.

One aircraft for which this extension will be of little consequence is the Pushpak, India's first light touring aircraft, built by H.A.L. as a private venture (something of a contradiction in a nationalized company?). The prototype, VT-XAA, is finished in blue and red, and has recently been on display at the "India 1958" exhibition in Delhi, where it attracted much attention. Indeed, Hindustan have been almost embarrassed by the interest that the little two-seater has excited; it is understood that the Board has still not unanimously decided to go ahead with the project. If it does so (the managing director, A.V-M. A. M. Engineer, seems keen that it should) then a separate division of the company will be formed in order to divorce the Pushpak production from general works overheads; a low selling price is most important, and it is aimed to retail the aircraft at about Rs 20,000 (£1,540). Running costs should not exceed about 30s per hour.

The first aircraft was built, by hand, in less than six weeks and a second machine is now being constructed in the same ultra-simple jigs as the prototype. The two aircraft differ mainly in the choice of wing-spar material: a largish stock of imported spruce provided the wooden spar of the first prototype, but so much difficulty was encountered in selecting suitable shake-free lengths of timber that all subsequent aircraft are to have a new design of metal spar supporting the pressed light-alloy ribs.

Construction is extremely simple. The fuselage is formed from a triangulated framework of welded steel tubing; two sides are tack-welded on a baseboard jig and the third (lower) side of the three-cornered frame is added in the welding jig. The Pushpak bears a superficial resemblance to an Auster, but a slightly more sophisticated fuselage cross-section has been adopted. This is formed by light wooden bulkheads carrying wood stringers, the whole being covered with fabric. Tailplane, fin and rudder are constructed entirely from steel tube and are of constant thickness with zero camber. A few castings (from the extensive H.A.L. foundry) are used in the construction—e.g., for the rudder pedals—but most fittings are fabricated from welded steel sheet.

Power unit of the first few Pushpaks (probably the first 20) will be the 85 b.h.p. flat-four Continental. But from the twenty-first aircraft onwards it is intended to offer the Pushpak as the first all-Indian aeroplane powered by the first engine of Indian design and manufacture. This is now being constructed by H.A.L. at Bangalore. An air-cooled flat four, the Indian design has attempted to combine the best of Continental and Lycoming engine practice. Progress is encouraging.

At the time of my visit last month the crankcase top and bottom halves were complete and had been line-bored, connecting rods had been machined, valves had been turned from valves of larger size and experiments were being undertaken to determine the correct interference between the screwed light-alloy cylinder barrels and their steel sleeves. The camshaft and crankshaft were complete, the billet for the latter having been rough-forged to establish the grain flow and subsequently extensively machined.

Every sort of pitfall, foreseeable and unforeseeable, besets the designer of an aero-engine, but in this case Hindustan's "learn slowly" policy seems sensibly cautious, and a ready market should await an American-type engine of this kind in a dollar-starved South-east Asia and elsewhere.

The Pushpak was completed just in time to be test flown (on September 24) before the opening of the "India 1958" exhibition in Delhi, where it appeared on an open-air stand of its own. It was flown up to Delhi and is reported to be very easy to handle. In the cockpit are two control spectacles; pedals with differential toe-brakes; push-pull throttle; fuel primer; and carburettor heat control. There are no flaps and no parking brake, and the cockpit is kept as simple as possible. A fire extinguisher is fitted and the bench-seat is adjustable; radio can be fitted in the luggage compartment behind the seat, access to which is from the cockpit. Instruments (A.S.I., altimeter, compass, bubble slip-indicator, r.p.m., oil temperature and pressure) are of American origin, actually stockpiled instruments that have been adjusted and equipped with re-calibrated dials. Ailerons are of the Frise type and are differential in operation. Performance figures quoted were: maximum speed 115 m.p.h., cruising speed 86 m.p.h., and stalling speed 35 m.p.h.

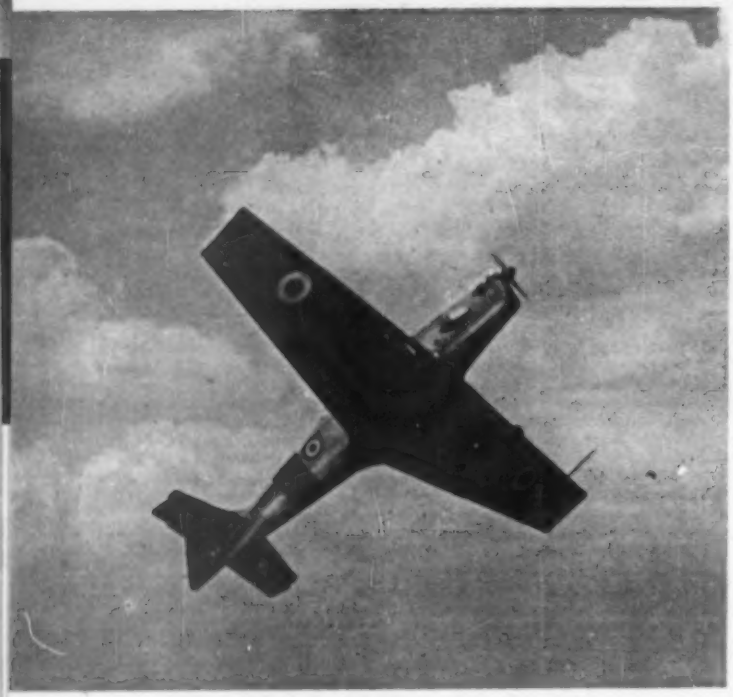
Although described as an ultra-light, the Pushpak weighs 872 lb empty and may be loaded to a maximum weight of 1,350 lb. The prototype has not been in any way specially finished and did in fact bear signs of rather rapid completion and rigging for the exhibition. Hindustan say that they are more than willing to make design changes in the light of demonstration criticisms and experience, and it is intended to bring a Pushpak to Great Britain as soon as possible. Enquiries for it are already coming in; one flying club has asked for five and there has been a surprising demand from tea planters and others in isolated communities.

As outlined above, Hindustan's range of effort embraces overhaul, assembly, construction and design of almost all types of aircraft, and includes the maintenance of one helicopter, an S-55. In some of this work, the company already has considerable experience, and the constructional standard achieved on H.A.L.'s assembly lines is high. Where local experience is limited, the company is expanding cautiously, adopting a step-by-step technique of a kind that might have been the salvation of more ambitious projects elsewhere around the world. Here and there—in the construction of the engine shop, perhaps in the tackling of two new designs at once—bold steps forward are being taken. Repeated all over India, this is the process of the country's industrial and national resurgence. To the Indian nation the part played by H.A.L.—favoured child of a tautly-stretched economy—is a very important one indeed.

Indian Industry—2

HANDLING THE HT-2

ALTHOUGH the Hindustan HT-2 basic trainer has now been flying for some years, and is in service in quantity with the Indian Air Force, it has yet to become well known outside South-east Asia and Australia. In the absence of first-hand knowledge it has frequently been described as "an Indian Chipmunk"; and in view of the widespread occurrence of this little animal in India, Chipmunk might not have been a bad name for the HT-2. As it is, the Hindustan company's product has not been named and is known only by its type number. It will certainly bear comparison with the Chipmunk, but it is not against its Canadian counterpart that it should primarily be judged. The HT-2 is the first aircraft of Indian design to go into production, the first Indian aircraft ever to receive a certificate to fly and the first indigenous design to be adopted by the Indian Air Force for operation under quite rigorous local conditions. The I.A.F. are generally very satisfied with their purchase and the aircraft is now also in service with various flying clubs; several having been purchased by the Indian civil aviation authority for airline pilot training.



Neat and robust, the HT-2 is now in service with the I.A.F. in considerable numbers. More are still being produced

HANDLING THE HT-2 . . .

The HT-2, conceived in 1948 by a team working under Dr. V. M. Ghatage, Hindustan Aircraft's chief designer, flew in prototype form on September 13, 1951, and the first Cirrus-Major-powered version (i.e., the first aircraft to be representative of subsequent production machines) flew in 1952, the Indian type-certificate being awarded a year later.

A number of modifications, particularly in respect of the fin and tailplane, the areas of which were quite substantially increased, were made in the early stages of the development programme to improve the spinning characteristics. Spinning may now be carried out at either forward of aft c.g. positions although there is a difference in characteristic. Various other minor changes have also been made, notably to the undercarriage and the brakes, and the prototype aircraft has recently been lengthened experimentally by inserting a new section in the rear fuselage.

The Blackburn Cirrus Major III engine, developing 155 h.p. for take-off, was chosen in favour of the slightly less powerful Gipsy Major because the HT-2 is heavier than the Chipmunk. Fully loaded it weighs 2,240 lb.

Thus, when my own opportunity came to fly the HT-2, the aircraft had behind it many hours of instructional flying. The machine I was invited to fly was IX 854, newly off the production line at Hindustan Aircraft at Bangalore, and destined after test to be delivered to the I.A.F. as a basic trainer. It was one of a recently completed batch, in fact at the time of my visit, it had yet to make its first flight. Armed with the comprehensive pilot's notes, which I had taken an opportunity of studying, I presented myself on a warm morning in November to F/L. Roy, a company test pilot and, like the others, a serving officer in the I.A.F.

Over the inevitable yet invariably welcome cup of *chai* I was briefed on what I might expect of the HT-2. We swopped impressions of the differences between the HT-2 and the Chipmunk, in which F/L. Roy was very interested and which he had yet to have an opportunity to fly. I learned that he had been the pilot of the HT-2 which had been demonstrated in Australia and New Zealand last year. Thanks to the exceptionally robust construction (the HT-2 is stressed to 10g positive and 3g negative) he had survived an accident during a spinning demonstration in which he had miscounted the number of turns and had been left with insufficient height to recover; but his confidence in the spinning characteristics remained unshaken, as he demonstrated later. As my time was limited, we agreed that the demonstration should take the form of a pupil's familiarization flight, with F/L. Roy demonstrating various manœuvres before I tried them for myself. He was also anxious to perform a limited programme of production aircraft tests, such as a dive to maximum speed.

After a careful check on the fit of my parachute in a chair in the pilots' office, and clad in an overall bearing I.A.F. wings (which I was proud, but of course quite unentitled, to wear) we went over to IX 854 for a pre-flight check and cockpit familiarization.

The cockpit sill is fairly high, but steps (spring-loaded flush for the front, fixed for the aft cockpit) are provided to assist the operation of clambering in. Once installed and with the quick-adjusting harness done up, one finds the space adequate and the cockpit quite comfortable. The six flight instruments are grouped more or less symmetrically in the centre. From left to right are an A.S.I., indicating up to 300 m.p.h., an ungraduated needle-and-bubble turn-and-bank indicator and a rate-of-climb indicator, while below this trio are an altimeter, artificial horizon with a caging knob and flag, and directional gyro. Engine instruments—r.p.m., suction gauge and oil pressure—are on the right, and a bowl compass and fuel-contents gauge on the left. The latter is of the electrical type which reads "zero" until contents indication is selected with a "port-starboard" switch. Reading is very positive and proved to be dead-beat even in the air.

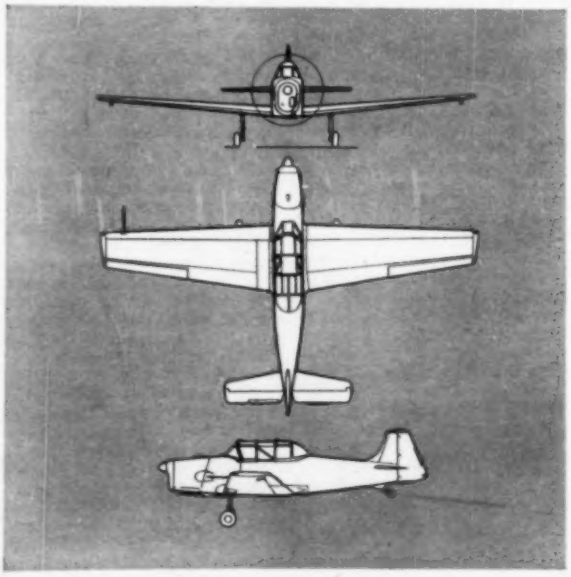
The HT-2 is flown on either of the 13-gal wing-root fuel tanks alternately, and one tank can be drained almost completely dry provided sufficient height is available to permit seven seconds to elapse before the engine picks up again on the other tank; normally the fuel-tank selector mounted on the floor on the right-hand side is used to maintain the fuel levels in each tank approximately equal; this entails more fuel-system management than is usual with a trainer.

Also on the right-hand side of the cockpit is the parking brake. There are no subtleties to this; it works on a ratchet, like a car handbrake. The flap lever, on the opposite side, is directly coupled to the flaps and, as a result, is weight-biased to the full-down position of 30 deg deflection. There is a ratchet palm-grip of generous proportions on the handle, but it is difficult to release the lever from the "up" or "10 deg" positions: the trick is to press the lever forward slightly first and then catch the weight of the flaps to prevent the lever banging back to the fully down position. Once the knack is discovered, the operation is fairly easy, and much more so in the air than on the ground. Nevertheless, I barked my knuckles the first time I tried it, and felt that a counter-weight or a spring might make the operation lighter; the ideal for all position controls is that they should work at zero load.

The only other controls that need to be mentioned at this stage are the elevator trim, a conventional scalloped wheel and—I was delighted to see—a similar control working in the correct sense for the rudder. Elsewhere I had heard the control column criticized on the score of inadequate length, but it suited me well and in any case could not be lengthened and still clear the instrument panel.

This inspection of our surroundings had taken a little time but, feeling more at home, I was invited to start the engine. The drill is simple. Fuel is turned to the fullest tank, the throttle set, American-type lever switch turned to the port magneto (which carries the impulse starter) and the shrouded button for the electric starter pressed until the engine fires. The magneto switch is then turned to "both." Above 1,000 r.p.m. the generator charge warning light goes out and the oil pressure quickly comes up to 40 lb/sq in.

After warming up and checking ignition at dead-cut and full throttle, we taxied down the runway to the take-off position. The rudder is ineffective at low speeds, and taxying must be done on the toe brakes at the top of the big plate-type rudder pedals. Even at full extension of the adjustment there is no possibility of stretching the legs right out, and as fairly high pedal pressures are required for small-radius turns it is not at first easy to obtain precise control. The tailwheel castors through 70 deg but is not coupled to the pedals (although Hindustan are considering a modification to couple it to the rudder) so that movement of the



ESPECIALLY in recent years, there has been a great search for new ways of saying, "Merry Christmas". We have watched this search with interest, for, as you may have noticed, we at Fairey are very much in the quest for new and better things. But, frankly, in this particular case, we have been forced to the conclusion that none of the smart new greetings can quite equal the old, simple, original one.

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HANDLING THE HT-2 . . .

pedals must be resisted with one foot while the brake is applied with the toe of the other. There is nothing very difficult about the action, and pupils quickly become accustomed to it, but a little concentration is required. Suspension and stability on the widely spaced wheels is excellent.

For take-off, rudder trim is set fully to port and flaps left in the up position. The rudder quickly becomes effective. I had feared that the rather strong cross-wind would make a little brake necessary to keep straight initially and had my feet up on the pedals where I could get my toes to the brakes. Had I kept my heels in the slides, IX 854's first take-off might have been a little less untidy.

A strong push force is needed to bring the tail up, followed by a positive backward movement of the stick to lift the aircraft off the ground, when it quickly settles into its climbing attitude at an indicated speed of 75 m.p.h. at the normal full-throttle climb r.p.m. of about 2,200. About 145 b.h.p. should be produced in this condition, but loaded the HT-2 weighs 2,240 lb and the rate of climb is not very high. Bangalore is 3,000ft a.s.l. and an initial rate of climb of about 650ft/min had dropped to below 500ft/min by the time we had reached a safe aerobatic height of about 7,500ft.

In all three axes the controls, which operate through push/pull rods to the metal-clad surfaces, seemed light and effective—particularly the rudder, which is also the most sensitive. Like most of its tribe, the HT-2 requires positive rudder movements with each change of power and is an excellent piston-engined trainer in this respect. Although the aircraft is positively stable in all planes, the margin is not large and the HT-2 requires to be flown—and the controls co-ordinated—most of the time. Nevertheless, it can be trimmed to fly comfortably and solidly in straight and level flight at just over 100 m.p.h., when there is quite a good view over the long flat-topped nose. A particularly pleasant feature is the individual sliding canopy (with jettison handle) for each cockpit, which can be kept open or closed as you please—even during aerobatics—and provide a chance to keep cool in air that is hot several thousand feet above the ground.

As an introduction to the HT-2's low-speed handling, I tried a series of stalls with and without flap. Like the Chipmunk (it seems impossible to avoid comparison), the HT-2 has a beak spoiler at the wing root and the stall is innocuous. With no flap, lateral control remains quite good down to buffet speed of about 60 m.p.h. The stall occurs at about 56 m.p.h. with little tendency for a wing to drop, and although the nose dips quite sharply little height is lost. Stall with flap occurs at a slightly lower speed, and in this case the starboard wing dropped away. Care in holding the wings level reduces the tendency.

With the modified tail, spinning is a safe and straightforward exercise that may be performed dual or solo, although the pilot's notes warn that when stabilization occurs, after three turns, recovery will require another 1¾ rotations. F/L. Roy was quite anxious to show me eight turns, but bearing in mind the loss of height that would be entailed, and the time needed to climb up again, we compromised on four. The manœuvre is easy to initiate and with full rudder the HT-2 drops quite quickly into auto-rotation, although I gained the impression that the rate of spin fluctuated during each turn. Full left rudder followed by full forward stick brought recovery in 1¼ turns and was completed with quite a steep dive out.

When diving—particularly at the start of aerobatic manœuvres—it is only too easy to exceed the r.p.m. limit of 2,450 and it becomes necessary to throttle back appreciably when entering, say, a loop, at about 145 m.p.h. At the maximum diving speed of 180 m.p.h. (which IX 854 achieved comfortably on its test) the throttle must be completely closed.

Given the excess speed of a preliminary dive, the HT-2 performs aerobatics a great deal better than its rather gentle cruising performance would lead one to expect. In a loop, rudder is needed to keep straight with changes of thrust and, as power is limited, the aircraft must be pulled fairly smartly over the top; but it is perfectly possible to "pull a quick one" at 125 m.p.h. Initiation speed for a roll is 125-135 m.p.h. F/L. Roy showed me a neat slow roll, using plenty of top rudder and forward stick, and something akin to a barrel roll "where final direction is not very important, but no height is lost." Next we each did some stall turns with the airspeed right off the clock at the top of the climb. This is an evolution that the HT-2 performs very well, cartwheeling lazily across the horizon before being checked with both rudder and full aileron into the dive.

These aerobatics rather hastily completed, we returned to the circuit for a landing. There is little change of trim when lowering flaps (80 m.p.h. is the limiting speed) and the approach is made at 70 m.p.h. in the glide or 65 m.p.h. under power. In this condition, possibly because the overall speed range is low and control forces remain little changed from the cruise condition, the HT-2 feels very steady and very comfortable, while the flaps are powerful enough to give an adequate rate of descent; I do not think that there could be any complaint on the score that the HT-2 was under-flapped. The round-out and landing presents few difficulties, plenty of elevator being available for getting the tail down and the rudder remaining effective to the point of touch-down. The Hindustan oleo-pneumatic undercarriage is said to be very sturdy (it certainly looks it) and is clearly well-damped. When the aircraft is rolling, brakes are necessary to keep straight, and again I struggled with rudder pedals and toe brakes with which I was not entirely comfortable—although in fairness it must be said that the great many pupils who have learned to fly on the HT-2 have experienced no trouble.

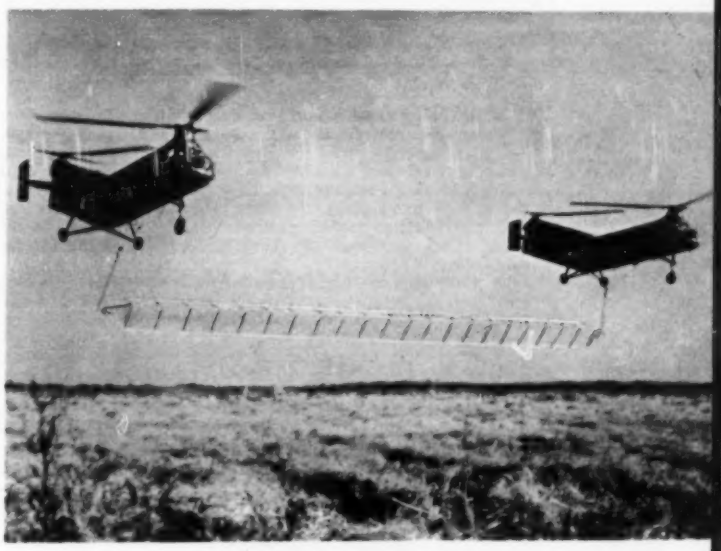
To sum up, I found Hindustan's trainer pleasant to fly, although some concentration is required. It has an intangible feeling of great strength and has been proved to be very strong. If it lacks anything it is in the power available—particularly since, unlike those of this country, some of India's training aerodromes are several thousand feet above ground level. By and large, the HT-2 adds up to a design of which the young Indian aircraft industry can be proud.

Hitching a Helicopter Lift

THAT two (or more) helicopters are better than one when it comes to lifting heavy loads is the idea underlying work at present being done by Vertol Aircraft Corporation, Morton, Pa. Under a U.S. Army contract, the corporation is developing what is officially known as the "multiple helicopter heavy lift system"—a method of harnessing helicopters as teams of aerial workhorses for short-haul lifts of heavy military vehicles and materiel.

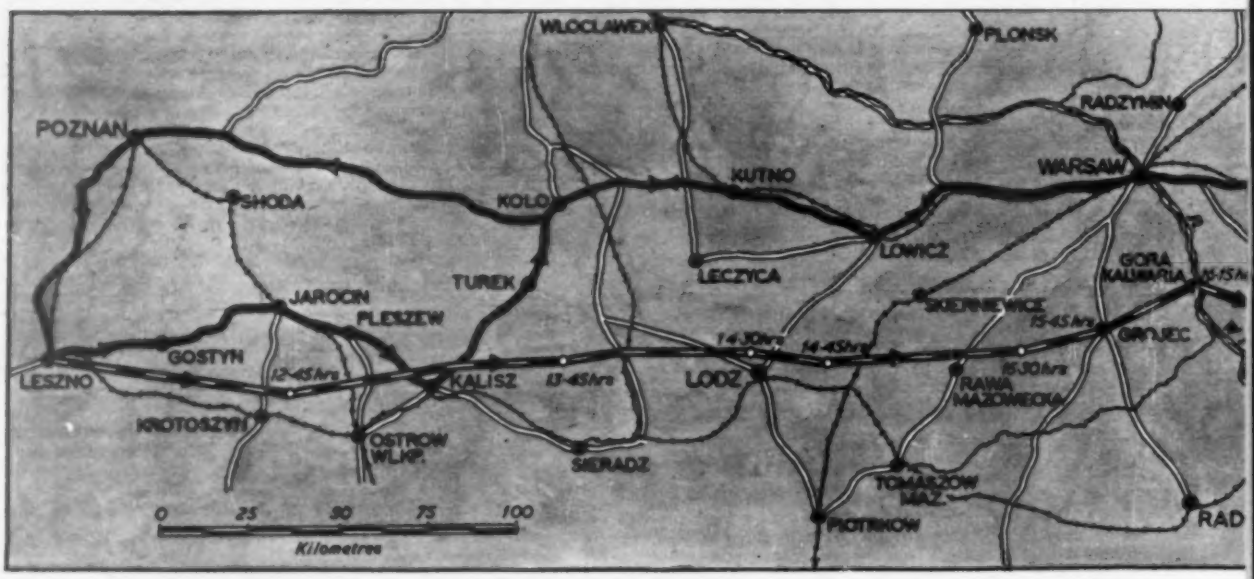
The basic equipment for this purpose is an aluminium alloy spreader frame to which the helicopters and cargo are attached by cables. The ends of the frame, which is triangular in section, are tapered to points and these are attached to the helicopters by ten-foot cables. Longer sling cables extend downwards from the ends of the frame—which is 113ft long and weighs approximately 400 lb—for attachment to the load being carried. An electrical release system is provided to enable the pilots to uncouple all members of the team in an emergency, or for normal detachment; though normally only the command aircraft in a multi-lift would make the release.

Loading and unloading may be done with the helicopters and spreader frame (or frames) in the air, with the aircraft just airborne and the frames on the ground, or with everything grounded. The Vertol test programme is to include trials with two, three and four helicopters successively, and of co-ordination between flight and ground crews during loading and unloading.



Two Vertol H-21 Workhorses harnessed to the frame—a 113ft light-alloy girder—from which heavy loads can be suspended

THE MUD OF MAZANOOVKA



EVERY long cross-country soaring flight really consists of two adventure stories, not one. In the morning the sailplane emerges from its chrysalis, and shortly afterwards the pilot sets off to test his skill and fortune. At the same time his crew leaves on a retrieve which may call for equal qualities of initiative and much more devotion, and produce hazards and surprises as great as anything experienced by the pilot. In the evening, if all goes well, the twin threads recombine for the journey home.

Now, although many flights have been written up, the retrieving teams have so far been surprisingly silent, yet their skill and ardour form a vital part of the whole. In what follows therefore I am trying to present to the reader the whole story of one single long flight, and to indicate the debt owed by all pilots to the faithful crews who get them, somehow, back to base, to fly again on the morrow.

* * *

June 25 was the big day of the 1958 World Gliding Championships at Leszno, in Poland. Also it must have established a record for total mileage flown in one day without engines: no one has yet worked it out, but the 62 competitors must between them have flown over 15,000 miles, and their retrieving cars must have covered well over double that formidable distance.

The day dawned bright and fairly hazeless, and the weather forecaster gave us winds from the west-southwest, 15 km/hr, veering to west as we flew eastward, with cumulus based at 5-6,000ft giving lift of 1½-2 m/sec. Towards the afternoon large cumulo-nimbus, tending to spread out and clamp, were expected in the north-east area of Poland, and towards the south-east smaller cu-nim were forecast with less risk of such over-development. There was a murmur of excitement from the 62 competing pilots when free distance was announced as the task for the day.

A glance at the map of Poland will show the alternatives facing us. Centred on Leszno, a 500-km radius indicates that to the north-east a considerable sector gave us the opportunity of covering about 510 km before reaching the Russian border. South of this a considerable sector of Russia cuts in and gives a maximum range of under 500 km; south again, about 535 km is available at one point, with a long sector nicely above the magic 500.

On the forecast winds, therefore, we could either set off straight downwind as far as Warsaw, and then attempt a final leg north of east (across the wind-direction), or start slightly across-wind, making for a point south of Warsaw, then veer slightly south-east to go for the maximum possible distance. Course 1 gave rather more risk of premature landing behind an over-developed cu-nim, so most of us (including me) decided to try course 2.

Now came a most maddening error. We had been told to have our machines on the starting line by 10 a.m. for take-off to start at 10.30, but at the last moment a question elicited a forecast from met. that cumulus would not start to develop before noon, and so the take-off was deferred until eleven. No sooner had we got to our machines, however, than the first puff appeared overhead, and the unfortunate rigidity of the organization prevented them from reverting to the original starting-time. So we all sat champing on the ground for an hour (longer for we unfortunates in the standard class, launched last) listening to the tinkle of our 500-km diamonds falling out of the window. I was actually launched at 11.35.

The Polish aeroplanes used a very short towing line 20 metres long. This looked very alarming at first. The little green machine struggled gallantly up, and with its tail well down you looked at its plan-form and seemed to be peering over the tow-pilot's shoulder at his instrument panel. In fact, if you could see his airspeed indicator, you were about right for height. If you could in addition see his oil pressure gauge you knew you were too high. At 11.45 I was waved off at 800 metres and at last was off on my *fifth* attempt for my diamond distance.

Releasing into the first thermal in a large championship, one flies straight into fairyland. Every rising column near the airfield is marked by a swarm of circling and climbing sailplanes of all shapes, sizes and colours, and one flies over to the best-looking flock and joins in at the bottom.

We smaller machines could circle more tightly than the larger ones, and so often could climb more quickly; it was like being a goldfish in a large bowl of goldfish, swimming silently round together towards the top. Around the swarm of small fish swam the larger fish in wider circles. Often one would be so near another that every detail of the pilot's face and clothes, and even his instruments, could be seen. But so high is the standard of pilotage that the entire silent and mysterious dance of the swarm felt as safe as it proved to be.

Each aircraft as it climbed near the top of the upcurrent would dart off on its course towards the distant east, and as I myself reached the top I looked down on a 2,000ft deep column of beautiful aircraft circling in a kind of stately gavotte over the green Polish countryside.

By now the sky was full of cumulus, though it took me 20 minutes' cautious circling to work up to safety at a cloudbase of 4,000ft. During this time, however, I safely passed the first 15 miles to Gostyn, which had on previous days proved my downfall. On this occasion I knew that my retrieving car was nervously following along on the road below ready to catch me if I fell, for a rush back for a second start at Leszno.

The Polish countryside, except for the mountainous region on the southern border, is not monotonous—in summer anyway—but it is all very much of a muchness and rather like the flatter parts of Cambridgeshire. For 300 miles to the Russian border it consists of endless flat fields of waving corn, grass and roots, with areas of woods and forests and a fair number of slow-moving rivers. There are no hedges, so that we were at last flying in a country where landing was no problem at all, and this no doubt is one of the reasons why in 1958 the exotic, regardless-of-cost sailplanes with higher air and landing speeds at last showed their paces.

By 12 o'clock I was safely at cloudbase, with all Poland before me bathed in sunlight and dappled with the shadows of cumulus, and with a fair wind nearly astern. Ahead and behind and on either side were the near and distant graceful shapes of my competitors, their many-coloured wings flashing as the sun caught them in their circles. Life has its brilliant moments.

But this is really more a story of a retrieve than of a flight, for this was the longest and hardest retrieve that Justin had ever done, involving nearly 800 miles with the 30-ft trailer in just 32 hours' motoring. Since the standard-class aircraft were not allowed to have radio, a combination of sheer intuition, allied to the rudimentary telephone system of Poland, was all that ensured that I was one of the first pilots to get back to Leszno the next evening. Justin is the name of my retrieving car and team, on this occasion a Vanguard estate car piloted as always by my wife Kitty, and by Harry Midwood. So over to Justin:—

* * *

We assemble our Skylark 2, polish it, Sellotape any unnecessary gaps and tow it gently over the grass aerodrome to its starting place in the lines of drawn-up sailplanes—the back row in the standard class, almost the last of the 62 gliders to take off.

We collect our pilot's lunch from the jeep which comes round, sort it, putting what we consider eatable in the air into the pocket in the cockpit and the rest into our car. Philip arrives from briefing and gives us our instructions. He tells us to head east towards Warsaw and to shepherd him over the first part in case he comes down early and wants to be driven back in time for a second launch. Last launching time today is 4 p.m. If there is no news of him by the time we reach Warsaw we are to do whatever we think best, according to what we have seen of the weather.

Harry and I leave him to be launched by Ray Stafford Allen and make for the trailer, hitch up, then rush over to the mess to collect our crew lunches, but find they are still not ready, so have to leave without them. Never mind, we have lots of bottles of fizzy yellow and red drinks left from other days, Polish petit beurre biscuits, one or two bars of Frank Irving's peculiar Imperial College concoctions and a wonderful Dundee cake that had been presented to us and which we had been keeping for a rainy day—also the remains of Philip's lunch which we hope he won't be down to want.

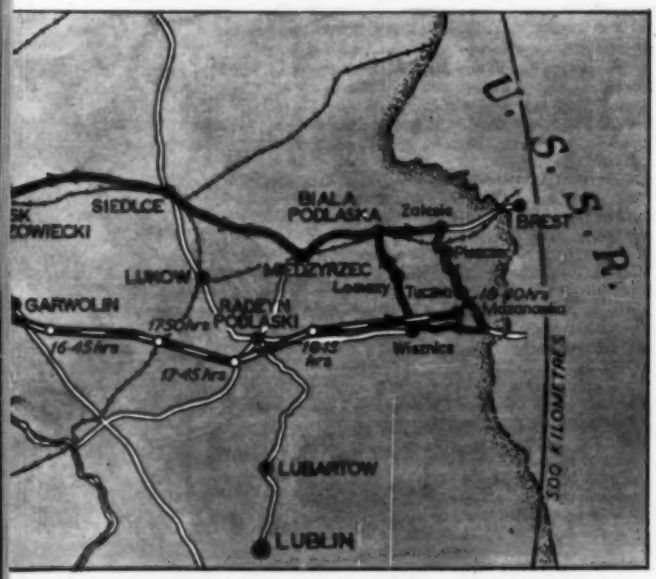
We turn on our car radio and tell the team control car that we are leaving the airfield, but they are too busy to be interested and so we drive quickly off, through Leszno, and stop on the edge of a large wood which the gliders have to go over.

It's a nice sunny day with rather weak-looking clouds. Harry sits on the roadside looking through his binoculars for Philip, amongst all the groups of gliders twinkling in the sunshine coming towards us. Nick is overhead at 11.15, then we see Tony—they go off over our wood. A shout from Harry: he has found Philip on aerotow, he can see his red wing with one white tip. We can hear Nick's voice getting more cheerful as he gets a bit more height, and Tony's voice is getting fainter.

Our pilot is dumb, as he is not allowed radio in the standard class, but we see him overhead—it is now 11.45. We dash to the other side of the wood and pick him up again. He is gaining height quickly, and goes to the north of the road. We dash on as fast as we can but he is out of sight, flying fast, at 12.10.

We rush through Gostyn and work out how long we dare leave

By PHILIP AND KITTY WILLS



The routes taken by pilot (broken line) and retrieving crew (solid line) between Leszno and Mazanowka—which is spelt phonetically in the title of the article

SKETCHES BY GORDON HORNER: MAP BY JOYCE BURCH

"So we all sat champing on the ground for an hour or longer, listening to the tinkle of our 500-km diamonds falling out of the window . . ."

THE MUD OF MAZANOOVKA . . .

telephoning and yet have time to find him where he has landed, de-rig, get him back to Leszno and launch him again. We decide we must telephone not later than 1.30 as it will certainly take us some time to get through.

Just at the right moment a village turns up, and in the first few houses is one with a plaque over it—an "administration house" of sorts. We stop, rush up the wide, dark, dingy stairs, find a door on a landing with some official-looking writing over it, knock and go in. There is a telephone on a table and three men and a boy, a bed and a chair or two. We put our "understanding form" in front of them and they all read it at great length. They offer us chairs and then put the number through. The bell rings; we hope it is for us, but no such luck. It is a previous call that one of the men had been waiting for. Then starts what seems to be an endless conversation. At last it is over, and then another tinkle. It is ours this time.

A very short conversation, "Nieme komunikazi," he says to us. We beam all over, to his surprise (he not knowing that no news is welcome news to us). We thank him very much and say goodbye, using some of the very few Polish words we have off pat. We offer to pay but he says, "Nie," so we rush down and out and into the car.

Well, that's seen our pilot over the first bit, beyond where he could have been retrieved for a second try if he had come unstuck. What a relief. This first bit is always an agonizing responsibility and when out of the way one feels one can breathe again.

We now settle down to driving. Entering a village, we see an accident ahead on the road—is it a trailer? One of ours passed us a bit back. No, thank goodness—and then we see it's a child and a lorry, in the middle of the road, and knots of shocked and sorrowing villagers are waiting at the side for the police. We wish we didn't have to intrude; and go quietly by, feeling so sorry for them, and sick at heart.

* * *

Meanwhile, what had been happening to the Skylark 2—the egg this ardent spoon was chasing so devotedly? I had settled down happily to the routine of speed flying on a good day. In every second or third thermal I timed myself from moment of entry to leaving, and calculated my average rate of climb—which worked up as the day wore on to never more than 350 ft/min—good but not epoch-making. Setting my speed-cruise chart at this figure, I was flying on course between thermals at a speed of 55-65 kt.

In these conditions there is practically no difference in technique and in speeds to fly between a Skylark 3, to which I was so well accustomed, and the smaller Skylark 2, although the achieved average ground-speed is, of course, rather less. Every half-hour or so I spotted and ringed my position and time on my map, and worked out the average speed achieved, which remained throughout the day remarkably constant at 72 km/hr. The clouds were mostly quite shallow, and experiment showed me it was hardly worth climbing into them, although later on I found one or two which gave me an extra 1,000ft of good lift inside.

During the first hour I was flying over country we had come to know during the past week or so: over Gostyn of ill-repute, over the hamlet just beyond where I had landed and spent a long time trying to pronounce the name over the telephone to base. It spells itself MSZCZYCZYN. Next time you are in your bath, dear reader, try it out for yourself.

As I flitted on from cloud to cloud, the countryside below hardly changed; the faster you ran, the more you seemed to stay in the same place. At 2.30 the large town of Lodz came into sight to the south of my course. Here at last, I thought, is a place I can pronounce. However, the Poles had it again—they pronounce it Wooj.

For the last hour I had seemed alone in the dazzling sky, but now another white sailplane swam quietly into my thermal below me, and we circled and flew on together for another 20 minutes before I lost him. It was a reminder that in fact I was not on a lone joy-ride. In a radius of 25 miles or so were 61 other pilots, all mad-keen to get on a little faster and farther than I.

I was all the time crabbing slightly across the wind to make my easterly course, and at 4 p.m. a large river ahead was clearly the Wistula. As I got nearer and located myself by the town of Gora Kalwaria on its banks, I was about 35 km south of Warsaw, and now was the time to alter course a little more towards the south-east, to get the maximum distance.

Smoke from a factory chimney below tried to tell me that the wind direction had changed very much in my favour, but I was too old a hand to be caught by that. The surface wind always tends to blow slightly towards a centre of low pressure, but above 1,000ft or so the air blows *round* the centre, and the speed and direction of the air in which I was flying were shown only by the movements of the cloud-shadows. These, however, did show that the upper wind had veered slightly in my favour. But time was getting on, and the magic 500-km circle was still 170 km ahead. Would I reach it, or had the dead hand of officialdom snatched my diamond from my grasp once more?

A momentary panic. Crossing the river from Gora Kalwaria below were, without a shadow of doubt, two bridges, carrying a road and a railway. Neither was marked on my map. Could I be lost? A hasty check-up with other landmarks convinced me—a dangerous conclusion, but on this occasion correct—that the map was wrong.

As I flew on over the flat, green country below, the sky ahead and to the right of my course started, unmistakably, to die. Slightly to the left looked better, and in this direction, into the blind sector, I was forced. A quarter of an hour later the guts started going from the air even in this direction, and again I was forced more to the left. Instead of puffy cumulus everywhere, there were soon left only a few isolated clouds, each at what appeared to be maximum range. It was no longer a question of hurrying, of leaving each lift as my rate of climb began to fall off, but of hanging on to the very top and then setting off at slow maximum-range speed to try to reach the next cloud before it collapsed.

Certainly all chance of exceeding 500 km within the Polish border had gone. Should I risk all and try to overfly it into Russian territory? The hazard here was, not that I should not get back at all, but that formalities would be so protracted that I should miss one or more days' flying and so fall out of the Championships.

I turned this problem over and over as I spiralled myself up in a tired thermal under a decaying cloud over a large wood near Radzyn Podlaski, 85 km from the border. When I left it at 4,000ft I knew that, if I could find but one more such area of lift before the day finally died, the choice would have to be made. Dammit, only the week before, during the practice period, I had had my *fourth* attempt at this flight, and had landed at Jordanow in the Carpathians, only 15 km short, after 8¾ hours in the air. I *could not* throw away this chance, which literally might never recur. If it was offered, I would take it. Kruschev, here I come.

* * *

At last we reach the Poznan-Warsaw main road and we decide to ring back. Still no news, but it is now 6.40 and another two hours of precious daylight have been wasted. We decide to ring again the other side of Warsaw, where there is a fork, one road going straight on east to the border and the other branching towards the south-east.

An elaborate funeral goes by, with wonderful horses and everyone walking. In the next town an old man lies looking dead on the pavement, with people standing around him. To cheer me up, Harry says he's probably only drunk.

Warsaw—we stop for petrol just after the Palace of Culture and have a long conversation with a man who was stationed at Blackpool during the war. He tells us the way out is left, second left, left: we thank him, think we do this, find ourselves inevitably back at the pumps in record time. The man very good naturedly leads us out on his motor-bike, puts us on the right road, and waves us on.

Then suddenly another trailer, and it's one of ours. It's Frank, chasing Tony Goodhart, our other pilot in the standard class. We exchange news on our radio and then stop in the next village, Milosna, before the fork. I go into a shop to ask for a telephone, and a wonderful smell of cooking reminds me I'm awfully hungry; but there's no phone, so on we go. Harry has bought some cherries, and has been given a flower for his buttonhole which sets him up. I've been given a St. Christopher.

We get to the fork, and have to decide. The weather has been looking better to the east for a long time, so we decide to go straight on. If necessary there is a road running south along the border when we reach it.

We find the police station at the next town of Minsk Mazowiecki and settle down for another two hours' wait. We entertain the inevitable pink blancmange of children's faces pressed against the car's windows. We play our radio at them, then we talk to Frank on the wireless, and finally I go to bed in the back of the car, to their great interest.

* * *

I reached the last wisp of dying cloud in the sky, at 2,000ft, north of Wisznice. Would it lift? Sink fell off, I started to circle, I held my height. I searched the whole air under the cloud, but couldn't find lift. By now the wind had dropped, and even by staying where I was I was not making distance along my track. *Niet*, said Kruschev.

I set off on my final glide, flying at a precise 39kt. I flew along parallel to a wood, over a straight but rutted cart-track with little groups of hovels forming tiny villages along it. As I got lower, I saw it ended in a small village and at the head of it quite a large new building in course of construction. By stretching my glide to the last, I grimly carried on until a potato struck my skid in a field just beyond this house, and at 6.45 p.m. the flight was over. My first act was to lay my ruler on the map from where I was to that maddening 500-km line still just ahead of me. Twenty-seven kilometres short, and about 10 from the border. Oh well! . . .

(To be concluded)

OPERATION SMOKE-PLUME

FAIREY AIR SURVEYS UNDERTAKE STUDY OF LONDON FOG PHENOMENA

THE countrywide fogs of recent weeks have recalled only too clearly the visitations which paralyzed London during the winters of three or four years ago. The intensity of pollution rose then to a point where there was remarkable increase in the death-rate from bronchial complaints; and animals, notably prize cattle at the Smithfield Show, were also seriously affected. Such phenomena are generally caused by a temperature inversion, which, lying something less than 1,000ft above ground level, holds down atmospheric pollution and forms the basis of fog.

As part of its continuous research into power-station design, the Central Electricity Generating Board then decided to determine by visual observation, which was the only possible method, whether the efflux gases from power stations contributed to the formation of such fogs. Many of the tall chimneys used are actually designed to eject at high velocity the hot gases produced by extremely efficient burning of very large quantities of coal; the intention is to ensure that the gases disperse well clear of the ground. Operation Smoke-plume, as this test was called, was intended to ascertain whether the hot gases succeed in penetrating the inversion and escaping into upper air even during dense fog conditions.

The C.E.G.B. therefore chartered an aircraft from Fairey Air Surveys, Ltd., and enlisted the aid of that company's research department in making visual and photographic observations over the power stations from above fog. Discussions were held in September 1957 and personnel and aircraft remained on call, to make a flight when fog formed, until March this year. But the right conditions did not arise. The operation was again mounted during October and one flight was made in medium fog on the 28th of that month. A full-scale test in virtually zero zero conditions was finally run during the dense fog of December 4, and the accompanying photographs were obtained to prove that the hot gases from the power stations can indeed penetrate an inversion and disperse clear of the fog layer.

Considerable organization was required for the flight and it would not have been possible without the assistance of the M.T.C.A. and of the London Airport controllers under Mr. Woodruff, their S.A.T.C.O. Fairey Air Surveys provided Dakota G-ALWC ("Whisky Charlie") with Messrs. J. Hazard and F. Worton as captain and first officer respectively, and Mr. B. J. Attwell, research manager of Fairey Air Surveys, as supervisor. The C.E.G.B. was represented by Mr. G. England, development policy engineer. Special weather warnings were provided continuously throughout the two operational periods to warn the crew when thick fog was expected so that the aircraft (based at White Waltham) could be positioned at London Airport and the personnel lodged in nearby hotels in readiness for a take-off on the following morning.

The top of the dense London fog of December 4 as seen from a Dakota of Fairey Air Surveys, Ltd. The hot gases from the Brunswick Wharf power station on the lower Thames are emerging through the fog as two clearly defined plumes at upper left

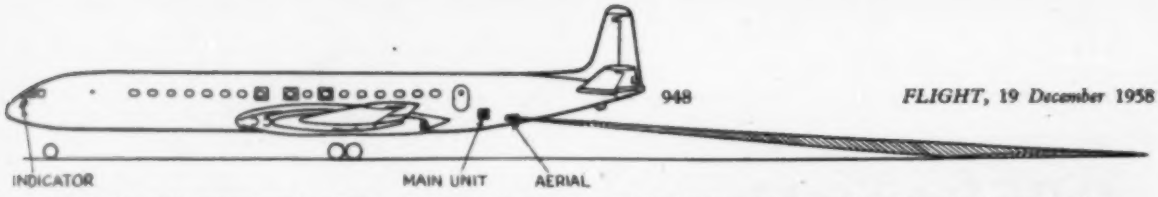
Whisky Charlie carried standard airline radio and I.L.S. with the addition of a Decca Navigator and Flight Log equipped with large-scale charts specially prepared to cover the area between London Airport and the area of three-mile radius over the lower Thames round the three power stations to be observed. A Wild RC.5A vertical and Williamson F.24 hand-held camera were to be used. A Pye mobile V.H.F. radio was also carried to provide a direct link with the power stations on their own communications frequency. During earlier flights messages had been sent by V.H.F. to London Airport and relayed by landline and they were thus audible in other aircraft flying in the area. One power station was being asked to colour its gases black for positive identification. The new Pope was at that time being elected in Rome and an American airline captain chipped in to ask the Fairey crew whether they, too, were electing a Pope.

The Decca chart, incidentally, marked the individual chimneys set about 300ft apart at each of the three power stations and the system proved to be highly accurate. It was realized that since the take-off would ideally be made under virtually zero-zero conditions, and fog might cover a wide area, a lengthy diversion would probably be necessary. Full fuel-load was therefore carried to afford some 8 hours' endurance.

A fog warning was received on the afternoon of December 3, the aircraft was flown to L.A.P., and the crew waited in their hotels. Fog came up with a vengeance next morning and Whisky Charlie was taxied out mainly with the help of the Decca Q-band A.S.M.I. in visibility officially estimated at well under 100yd. The take-off was virtually blind and precision radar guided the pilot straight on to a heading for the selected observation area. No other traffic stirred and, in fact, no aircraft took off or landed there until late in the evening. Whisky Charlie broke into clear sky and bright sun at 500ft and photographs were taken of the chimney gases emerging in clear-cut plumes from the top of fog, which was at about 700ft in the test area. The chimneys were 300ft high and the gases were therefore sufficiently hot and buoyant to break through the inversion 400ft higher up. Above the fog they were carried to leeward by the wind and dispersed in the normal way. It was noticed that no break-through was seen over Bankside power station, the gases from which are cooled by a washing process.

Following these observations, Whisky Charlie was flown back to London Airport and a G.C.A. approach, monitored by I.L.S., was made to check temperature readings taken after take-off and to ascertain that the fog cover was still complete. The pilots also wanted to make some assessment of slant visibility on the approach and to give the airport authorities some details about it. In fact the approach was continued down to 200ft without sight of the wing-tips, let alone the high-intensity approach lighting. Until a short time before, Southend had been open for instrument approaches; but this airport, too, had now closed in and a diversion to Guernsey had to be made. After an overnight stop, Whisky Charlie was flown back to London and the operation was concluded for the time being.

A closer view of the plumes, which were coloured red and black for positive identification, penetrating the top of fog at 700ft. The chimneys are 300ft high. A Decca Navigator receiver facilitated pinpoint plotting of the location of each chimney without sight of the ground



Distribution of the components in a Comet, showing the beam pattern originating from the waveguide aerial under the rear fuselage

Marconi Doppler Take-off Monitor

THE more critical take-off performance of heavily loaded jet aircraft and their need for an increasing proportion of the available concrete for the ground-run has made desirable an instrument which can positively and immediately indicate when take-off performance is falling below the required level. Accelerate-stop procedure must be initiated at the earliest possible moment, but it may be extremely difficult to notice a significant loss of acceleration by normal observation. A take-off monitor can provide a continuous, accurate check.

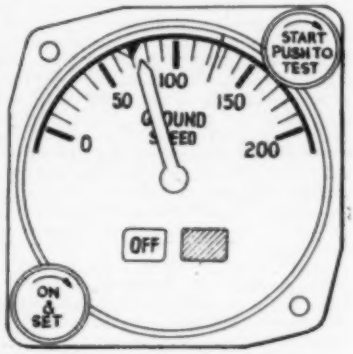
The International Federation of Airline Pilots' Associations held a symposium in London on December 4 during which six companies—Sperry, Kollsman, Avien, Minneapolis Honeywell, Servo Mechanisms, Nortronics and Marconi's Wireless Telegraph—gave details of various take-off monitor systems. Most rely on purely internal sensers and computers, but Marconi have evolved a Doppler system. Work has been in progress for some months, and a prototype should be flown this year.

Initial details issued by the company indicate that Doppler was chosen because it is independent of ground-based equipment and because it can conveniently provide an indication of speed and distance travelled. Acceleration, the third basic factor, can be directly derived from these by electrical differentiation. The accuracy of Doppler is within the one or two per cent required of the monitor; and the outputs, being electrical, are readily combined according to relatively complex laws. Correct time-constants are also important in providing early warning of loss of thrust and to smooth out response from momentary losses of acceleration caused by patches of water or slush on the runway. Marconi consider that a reliable and simple Doppler can be produced because of the limited range required.

Some of the problems which are expected concern the feasibility of using a low-powered transmitting valve when the beam is transmitted at the very shallow angle needed to avoid interference from pitch-attitude changes. This may arise even though the required range is very short. Furthermore, the simplest frequency tracker requires a strong signal and therefore aggravates this problem. Wet runways might cause loss of signal-return and yawing might introduce errors. Although a "backward-firing" transmission would avoid propeller modulation, it might facilitate reflection of misleading signals from water or objects blown rearwards by slipstream.

From studies so far completed, Marconi feel that these problems can be overcome and are proposing a Doppler monitor using X-band F.M.C.W. transmission from one or two fixed, single waveguides mounted on the aircraft skin—or flush with it if required. The electronic tracking system deriving acceleration, speed and distance gone would be fully transistorized. Speed range would be from 0 to 200 kt, an accuracy better than two per cent of full scale being maintained from 30 to 200 kt. Distance travelled would be continuously integrated, but would only be presented on the indicator when full velocity accuracy was available at over 30 kt.

During initial trials the velocity reached would be continually compared with that to be expected along the runway under normal conditions. An independent acceleration-senser would set off an alarm if that value fell by a significant amount. The accompanying diagram of the 3½in indicator shows how the actual-speed needle indicates the margin of performance in relation to the estimated-speed "bug" on the dial edge. Runway length remaining is shown by the scale distance between the "bug" and the index line which marks the V1 speed. An "off" flag is withdrawn from view only when signal strength is satisfactory. Relay contacts for additional alarm circuits would also be provided.



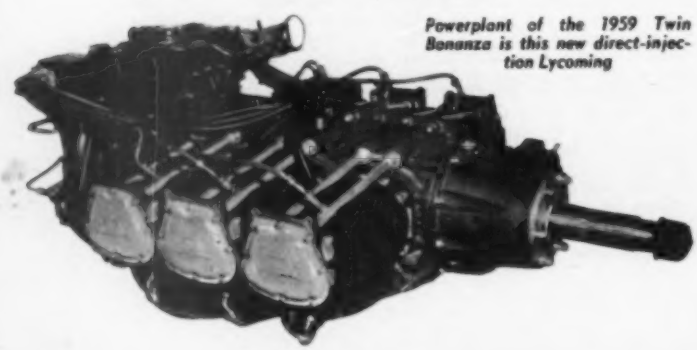
All controls and indications are grouped on a single instrument. The needle registers actual groundspeed, which is compared with the triangular "bug" in the dial rim to assess the margin of performance. The thin line shows the V1 value obtaining and indicates the length of runway remaining. Estimated performance can be set in the left-hand window; danger or malfunction are shown in the other window

The left-hand window in the dial shows a number corresponding to actual take-off conditions of weight, runway length, surface wind and temperature and is linked with the on/set knob so that a fresh setting must be made at each take-off. The other flag has three settings showing normal operation, loss of acceleration or unserviceability in the equipment. After setting the appropriate take-off number, computation is initiated after the "start" control is operated. The "off" flag then disappears when the needle starts to move after reaching 30 kt and reappears after take-off.

These details represent the initial proposal and tests will be aimed at assessing the relative merits of various alternative computations. The company is also investigating other approaches.

FUEL-INJECTION LYCOMING

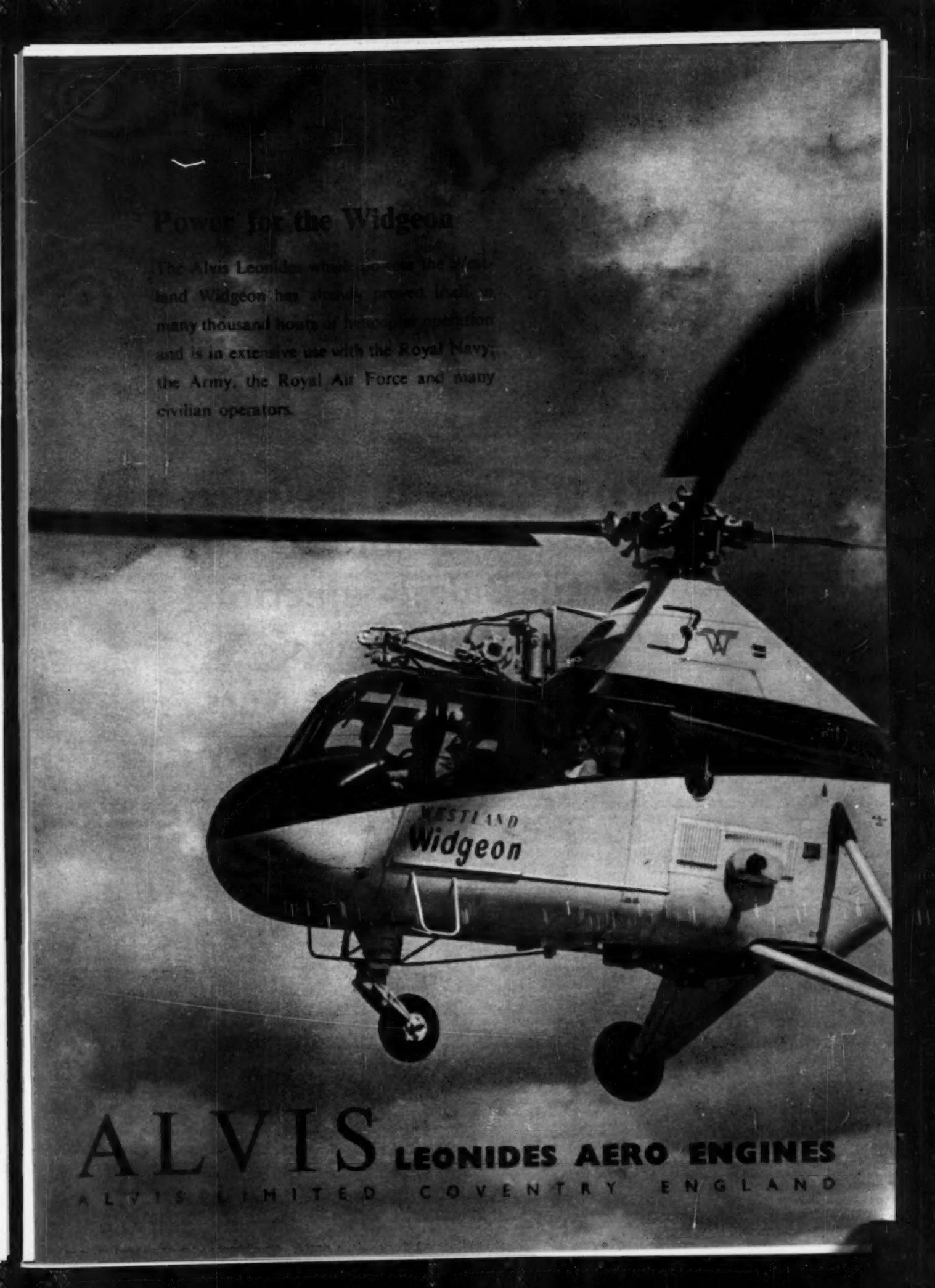
FOLLOWING the pattern established for American cars, there is an increasing trend towards the adoption of direct-injection piston engines for American light and business aircraft. The Lycoming Division of Avco have recently announced the IGSO-480-A1A6 as the most powerful fuel-injection engine for such applications, and the powerplant is now in production for the 1959 Beech Twin Bonanza. A flat-six, geared and supercharged engine, the IGSO-480 has a Simmonds Type 570 fuel injector, incorporating automatic altitude mixture compensation. This unit is mounted at the rear of the engine, reducing the overall height by 10in to a total of 22.29in. Operating on 100/130-grade fuel, the engine is rated at 340 b.h.p. and weighs 496 lb; at 60 per cent power the fuel consumption is 13 Imp. gal/hr.



Powerplant of the 1959 Twin Bonanza is this new direct-injection Lycoming

FORTHCOMING EVENTS

Dec.	31.	Kronfeld Club: New Year's Eve Party.
Jan.	3.	British Interplanetary Society: "Rocket Combustion Research with Liquid Propellant Engines," by Dennis S. Carton.
Jan.	6.	R.Ae.S.: Young People's Lecture: "Rocket Flight in Space," by Dr. L. R. Shepherd.
Jan.	8.	R.Ae.S.: "Safety in Mechanisms," by Raoul Hafner.
Jan.	13.	R.Ae.S.: "Stress Corrosion—the Engineer's View," by P. H. Wall.
Jan.	15.	British Institution of Radio Engineers (Scottish Section): "Satellite Development and the Moon Rocket," by P. H. Tanner (at Glasgow; repeated on Jan. 16 at Edinburgh).
Jan.	15.	R.Ae.S.: Presidential Address.
Jan.	16.	Institute of Navigation: "Blind Landing Problems," by W. J. Charnley.
Jan.	17.	Aircraft Recognition Society: All-England Contest.
Jan.	21.	Manchester Metallurgical Society (Institute of Metals): "Investigation of Metallurgical Failures in Aircraft," by D. A. Ryder.
Jan.	26-29.	Institute of the Aeronautical Sciences: 27th Annual Meeting.
Jan.	27.	R.Ae.S.: "The Noise Problem in Relation to Engine Design," by P. Lloyd.
Feb.	5.	R.Ae.S.: First Halford Memorial Lecture, by J. L. P. Brodie (at Hatfield Branch).
Feb.	7.	British Interplanetary Society: "High-energy Fuels and Rocket Propulsion," by Dr. F. Fitzgerald.
Feb.	9.	R.Ae.S. Guided Flight Section: "Theoretical Studies of Guided-missile Control Systems," by E. G. C. Burt.


Power for the Widgeon
The Alvis Leonides which powers the Westland Widgeon has already proved itself in many thousand hours of helicopter operation and is in extensive use with the Royal Navy, the Army, the Royal Air Force and many civilian operators.
WESTLAND
Widgeon
ALVIS
LEONIDES AERO ENGINES
ALVIS LIMITED COVENTRY ENGLAND

Over 250 safe ejections have been made in Martin-Baker ejection seats. Of these over 40 are pilots and observers of the Royal Navy

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America's Turbine Transport Progress

BOEING, CONVAIR, DOUGLAS AND LOCKHEED REPORT

By DONALD A. IMGRAM

New York, December 5.

"A PROGRESS Report on the Introduction of Turbine Aircraft" was the dominant theme of a series of speeches made at a dinner meeting of the Society of Automotive Engineers in New York City on December 4. Guest speakers were leading representatives of Boeing, Convair, Douglas, Lockheed, and Pan American. All of the speakers exuded confident enthusiasm for their products, although each admitted facing small problems during the development and introduction of the new turbojet and turboprop aircraft.

Boeing 707. Don A. Buck, manager of transport operations at Boeing, reviewed the status of the 707 programme and reported that his company's turbojet transports had now accumulated 1,300 hours of airline service. Total military operational flying time with the KC-135 (military derivative of the 707 transport) exceeded 115,000 hr. Load factors on PanAm's jet service to Europe had been well over 90 per cent. Mr. Buck apologized for this figure and indicated that steps were being taken to raise load factors to a "more profitable" level.

Mr. Buck went on to mention acceptance of the 707 by airport authorities at Le Bourget. Operations at this airport, he said, had not produced a single complaint about noise from nearby residents. The 707 was quieter than a Viscount at ramp positions on the Paris field.

Later in the programme Captain C. S. Vaughn, operations manager of Pan American's Atlantic Division, asserted that the turbojets were even better than they had expected. PanAm had made 120 crossings as of December 4, and the 707 had achieved an enviable record of on-time performance.

Convair 880 and 600. Convair's Hugh B. Duckworth, special assistant to the chief engineer, reported that roll-out of the 880 was scheduled for December 15. First flight was set for January 20. Barring unforseen difficulties, the 880 would complete "all preliminary flight tests and certification on or about May 1, 1959." First deliveries of the 880 to the airlines would begin next year, and delivery of the first Convair 600 to American Airines would be in June 1961.

Prospective users of collision-warning devices on turbojet aircraft would have to make provision for the possibility of being overtaken from the rear, Mr. Duckworth remarked, because the Convair 600, with a projected speed of 645 m.p.h., could overtake any other turbine aircraft now on order for the airlines. (Continuing in the same vein, he evoked gasps from the assembly when he claimed a speed of "Mach nine" for his company's transport; taking heed of the outcry, he hurriedly corrected this to "Mach point nine.")

Douglas DC-8. Ivar Shogran, chief project engineer on the DC-8, stepped to the rostrum and reported that the J57-powered prototype DC-8 (actually it is production aeroplane No. 1) had accumulated a total of 140 hr on 47 test flights. Only three hours of this time were devoted to public-relations flying. No test flight to date had been recalled because of in-flight troubles.

Flight testing thus far had been primarily concerned with investigating those items which might require "hardware" changes in the airframe. Douglas were particularly interested in this aspect of the test programme because they would have no fewer than 39 aircraft completed by certification date. Any retrofit hardware changes on such a large number of aircraft could prove quite costly.

Performance of the J75-powered aeroplane (No. 2 DC-8), which had made its first flight only a few days before, was so great an improvement on the lower-powered version that "Douglas might have a little trouble getting their pilots back into the first ship." The J75 aeroplane has been equipped with leading-edge slots solely for test purposes; there were no present plans to fit these on other DC-8s. Originally conceived as a modification for future-growth versions of the DC-8, the slots were being flight tested now so that they would be available for that purpose, or in case additional changes to C.A.A. regulations required further improvements in DC-8 take-off performance.

All DC-8 stall and stability tests had been satisfactorily completed. The aircraft was stable in Dutch roll and damped to half amplitude in 4½ to 7 cycles. Mach 0.92 had already been achieved; Mach 0.95 would be proven during C.A.A. testing.

Problems had been encountered with the DC-8 Freon cooling system—all manufacturers reported troubles with this item—but these had since been corrected. Douglas's major problem, however (but one which had since been resolved), was in cross-wind landings. The use of spoilers and ailerons alleviated this.

The lecturer showed a DC-8 progress-report film dated October 31 in which parts of aeroplane No. 25 were seen being assembled. Eight aircraft are now in final assembly. The movie included in-flight scenes of the prototype with a parachute deployed. The 'chute, described as being "for aerodynamic test purposes," was not unlike the spin 'chutes used by many American manufacturers as a safety precaution during spin testing.

Lockheed Electra. The remarkable progress of the Electra programme was covered by Carl F. Schmidt, operations engineering specialist at Lockheed. At least 121 Electras, he said, would be in service by the end of 1959. The only significant change to the aeroplane has been an increase in rudder area. Comparison of the original Lockheed "guaranteed" performance numbers with subsequently demonstrated values showed exceptionally fine correlation. But perhaps the most astounding figure divulged during Mr. Schmidt's speech was one recorded during a high-sink-speed landing. Quite accidentally, the Electra was once landed at a sink rate of 18ft/sec, a value which was 50 per cent greater than limit sink-speed (even seasoned carrier-based pilots wince at a figure this large). The hard landing, however, caused only minor damage.

The listeners to all these reports could not help but be awed by the magnitude of the development programme and the staggering sums of money involved in them. But perhaps the main fact impressed in the minds of many people was the close adherence of the manufacturers to schedules established several years ago. In several instances the schedules have been bettered. The ability to meet a schedule is a factor accorded serious attention by prospective purchasers of an aeroplane; and it is the ability of American aircraft manufacturers to meet their schedules which has partially accounted for the preponderance of their aircraft in post-war airline markets.

THE LONDON AIRPORT DISPUTE: COURT FINDINGS

IN *Flight* for November 14 the evidence presented to the court of inquiry ordered to investigate the B.O.A.C. engineering dispute was summarized at length. The report of this court, whose chairman was Professor D. T. Jack, was issued last week,* and a brief summary follows. A leading article appears on page 931.

The court finds that the overtime ban by 4,000 B.O.A.C. engineering employees which preceded the strike was unconstitutional. Its report suggests that the shop stewards' powers should be "circumscribed," and expresses the belief that improvements to the machinery of the N.J.C. are "possible and desirable." It was impressed with Mr. Eric Rylands' evidence on this point.

The report says that a militant minority at the airport was prepared to take power to itself, and to disregard constitutional arrangements when it thought fit. The airline corporations and the unions had been weak in the past when the shop stewards had acted arbitrarily. Certain unions were considerably perturbed about the effect of this behaviour on industrial relations.

The court finds that there has been inadequate leadership at various levels on both sides, saying that it was unfortunate that the chairmen of B.O.A.C. and B.E.A., particularly Sir Gerard d'Erlanger of B.O.A.C., "stood aloof" from discussions at a critical time.

The court describes as "mischievous" much of the evidence given by Mr. Ian Mikardo, M.P., chairman of the trades union side of the N.J.C., and Mr. Clive Jenkins, a member of the trades union side, "whose evidence we found to be evasive" and who had an "incomplete sense of loyalty" to the N.J.C. There is also, says the court, good ground for the view that the "dominant figure [among the shop stewards] was Mr. S. Maitland, who was, and is, a member of the Communist party," which did not hesitate to act in a disruptive manner.

In the court's view, the rank and file of the union's membership should consider "with the greatest care the suitability of the persons whom they elect as shop stewards." It does not accept the contention that there had been unnecessary delay by the employers in dealing with the wage claim, though the employers might have done more to make their position clearer to the unions.

* *"Report of a Court of Inquiry into the causes and circumstances of the dispute at London Airport existing between employers and unions represented on the National Joint Council for Civil Air Transport." H.M. Stationery Office, price 2s.*

Straight and Level

AS if air transport was not already complicated enough, look back to the recent purchase of five Convair 880s and four Caravelles by Swissair and S.A.S.

Like many others, I was interested in the amounts of money involved. Yet *you* try to obtain a clear picture from the official statements.

Convair, unlike Sud, wasted no time in reporting the details of the sale, and stated clearly that the 880s were worth "over $18 million."

The S.A.S. and Swissair version of the price, however, included spares, and quoted a total cost of "about $27 million." To this was added $15m for four Caravelles, to give a total of $42m. An initial spares-holding valued at 50 per cent of the aircraft cost seemed improbably high; these figures therefore appeared to include provision for subsequent spares.

Certain commentators must have felt that these amounts were hardly newsworthy, and the sale was soon elevated to a "£20m ($56m) slap in the face" for Britain's aircraft industry. For those interested, this figure is equivalent to cost plus a 100 per cent spares-holding.

But whether the sum was $18m, $42m or $56m, it was still a slap in the face.

● Mr. R. Harris (Conservative M.P. for Heston): "Will the Minister now consider removing London Airport to a coastal area?"

Oddly enough, the Minister did not accede to this request, leaving the way clear for Mr. Harris to ask for the metropolis itself to be moved instead.

● I have seen enough of the American IRBM game to make me thoroughly disheartened.

Discounting Corporal, the basis of the Army's work in the ballistic-missile field was the big Redstone, of some 250 miles range. From this they were trying to evolve a 500-miler (or thereabouts) back in 1954. Then the Defense Department told the Army to drop everything and do a full IRBM (1,500 miles), and this evolved as the Jupiter. Next move was to ask the Army to compromise Jupiter so that it could also be used by the U.S. Navy from surface vessels and submarines. Eventually the Navy decided to break away and do an IRBM of their own, and then, in November 1955, the Defense Secretary forbade the Army to work on any weapon with a range greater than 200 miles.

All land-based missiles with greater ranges were to be the sole property of the Air Force, and Jupiter was turned over to them lock, stock and barrel. Unfortunately the Air Force already had an IRBM project (just started), and so they proceeded to explain that they did not really wish to have any part of Jupiter at all. Meanwhile the American aviation Press—far larger and more widely read than any papers devoted to the Army—started a campaign to belittle Jupiter. Daily one could read "unconfirmed" stories leading to the "obvious" conclusion that Jupiter would be cancelled in favour of Thor, the Air Force weapon.

Oddly enough Jupiter has not been cancelled—yet—since its sheer technical merit has proved equal to the backstairs onslaught against it. Meanwhile the Army have been given permission to do a 500-mile weapon (Pershing), with possible extension to greater ranges. Next year, no doubt, these will be turned over to the Air Force . . .

● Alitalia will no doubt continue to press for a jet differential when the I.A.T.A. fares conference reopens next month. But they only want it as a short-term expedient until they too have jets. It seems a pity thus to abuse the right argument for the differential.

Sooner or later the airlines will recognize that they can never attract the tide of tourism Sir William Hildred was glowing about at Delhi until they moderate their obsession with speed. This obsession tends to put up costs, not because speed is necessarily more costly to provide—it is not—but because the airlines just have to buy the latest and fastest to stay in business. As a result, up shoot depreciation and capital charges. Meanwhile mum, dad and the kids continue to travel by rail and sea because it's cheaper.

The right argument for the differential is that it will check the re-equipment race. How? Because it will establish a class of air transport in which speed isn't everything.

And I have a feeling that B.E.A. believe so strongly in the fare differential that they will lead a movement to introduce one even if there is disagreement in I.A.T.A. But I would just like to be surer that B.E.A.'s case for the fare differential really is the altruistic one outlined above. Would they, I wonder, be as vehemently pro-differential if they had jets coming into service next year? Or, less hypothetically, will B.E.A. be as vehemently pro-differential when they have their 24 de Havilland jet airliners in service?

● An announcement of a new product always sets me speculating on the design-office agonies that finally lead to the publicity department's advertisement. I imagine the project engineer of an accessory firm arguing with his chief designer: "Scruggs Aircraft don't like welding. We must use bolts this time—quarter bolts in double shear." A nearby weights engineer blanches.

"All right—and we can use titanium-impregnated cotton wool insulation. Let's be up-to-date. In America complete aeroplanes are made of the stuff."

Detail drawings begin. Two draughtsmen get 'flu and the programme falls behind. The projects engineer reports that Scruggs have rejected the bolts as too heavy. A welded unit goes on test.

The contract-date arrives, *and* a reply-paid telegram from Scruggs. Somehow a unit is delivered, and the publicity department is allowed to photograph the shell of the second unit.

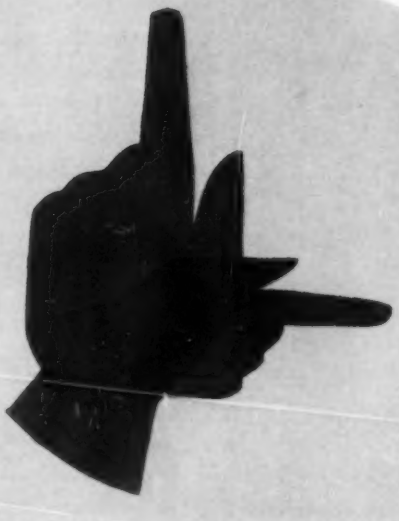
Of course, it doesn't *really* happen like this. What really happens is that the publicity boys are told to mind their own business.

● "This firm is so behind with its schedules," said the chairman of Scruggs Aircraft last week, "that I should be surprised if our annual Children's Christmas Party takes place before Easter."

ROGER BACON

Who said that the television aerial mast at Crystal Palace is a menace to air navigation? You can't (as they say) miss it. Here it stands out like a beacon from dense London fog, close to the north-east free lane from Croydon Airport. I am surprised we have not yet seen a small aircraft impaled on it, looking like a moth on a pin, or like the proposed R.34 memorial. For an explanation of who took the picture and why see page 947

BELL X-14 AND THE VIPER MAKE VTOL HISTORY



Bristol Siddeley

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The U.S.A.F.'s experimental Bell X-14 is the first jet aircraft in aviation history to rise straight up from a runway in the conventional horizontal position, fly round an airport traffic pattern, and return to hover and land vertically. The availability and reliability of the Armstrong Siddeley Viper engines made this possible. Once again Armstrong Siddeley have shown that wherever power is called for, on land, on sea or in — and even above — the air, they can provide it.

TEST AT M.I.R.A. PROVES QUICK STARTING WITH CASTROLITE

MOTOR INDUSTRY RESEARCH ASSOCIATION

In a recent test at the Motor Industry Research Association's establishment at Lindley, a Morris Minor was frozen in the cold chamber for 24 hours at a temperature of 30° below freezing. With Castrolite, the balanced multi-grade oil in the sump, it started first pull on the starter. The practical demonstration of this is being shown on all ITV channels during the winter months.

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Britannia — an Operator's Report

MR. J. E. D. WILLIAMS' R.Ae.S. BRANCH LECTURE

THE author of the lecture summarized on these pages was, until recently, in charge of El Al's Britannia operations. He is now consultant to that airline, and to C.P.A.L., Cubana and Aeronaves. His approach to the subject—a rare blend of the intellectual and the practical—has brought great credit to El Al and to the Britannia. The paper will be of general interest to all operators of turbine equipment.

THE main body of Mr. Williams' paper—which was given before the Bristol Branch of the Royal Aeronautical Society on December 4—was concerned with the technical aspects of Britannia operation: in the latter ("mainly pontifical") portion the author commented on some more general aspects of the aircraft in service, and these are dealt with first.

Future of the Britannia: There were, said the author, a number of airlines which had flourishing short-range operations (on which big jets were useless) and whose long-range operations were specialized, of low frequency, and often on one route only. For such operators there was "no sign of an aircraft which could compare with the Britannia 310," provided only that there was no jet competition. The author believed that the number of such routes was unlikely to grow less.

"Nuts and Bolts." A glance at the statistics of Britannia maintenance delays and failures showed that the overwhelming majority were due to items which were not manufactured by Bristol at all. Very often the first thing a foreign purchaser of the Britannia (or a Comet or a Viscount) did was to "throw out as much of the British ancillary equipment as he could." People who did it most were often people who knew their business as operators best.

The reason might be prejudice, or a requirement for standardization. Often it was simply that an American alternative was a better buy. "I am told," said the author, "that in the case of some systems and components there is only one manufacturer Bristol can go to. If this is so, we are lucky not to have done worse, and the manufacturers concerned are to be congratulated on their integrity in their non-competitive world. I would offer a very personal opinion that if British civil aircraft are to sell in the world markets, their designers must be free to buy the best components and systems and other ancillary equipment wherever they are manufactured."

After suggesting that certain chief designers might pay attention to such things as freezing washroom drains as well as to aerodynamics, the author continued: "Airlines usually tell the Press (and sometimes their stockholders) they have made a wonderful buy, and then tell the manufacturer that everything is terrible. I believe all Britannia operators complain to Bristol, as they should; but collectively they pay Bristol the nicest compliment. They complain most bitterly about quite different things."

The Economics of Cruise. Cruise control procedures were, said the author, normally designed to meet one of three requirements:—

(a) *Optimum Economy Cruise.*—This was the correct one to adopt when the required range was such that fuel uplift was not limited either by weight or capacity considerations. It was simply the minimum cost cruise weighted for whatever passenger attraction value was assigned to speed.

(b) *Maximum Range Cruise.*—It was not usual for a flight to be planned for absolute maximum range. If the fuel which may be uplifted only permitted a flight plan at absolute maximum range with minimum reserves, it was usually sounder to plan a stop for refuelling purposes and fly at minimum cost. More often, aircraft were flown for maximum range in order to conserve fuel when terminal conditions deteriorated or if headwinds. icing, etc., caused excessive fuel consumption on route.

(c) *Optimum Range Cruise.*—This should be adopted when the fuel available was more than that required for a maximum range cruise, but less than that required for optimum economy cruise. In operational practice it was simply the least-time cruise for a permissible burn-off of fuel. This was perhaps the most important case; it was the basic Britannia cruise-technique on the North Atlantic; on many of C.P.A.L.'s flights further north; and on Aeronaves' northbound leg from Mexico City to New York. The optimum-range cruise should, ideally, be the most general case for all turbine-engined aircraft. Range was too expensive a commodity to buy if it were not required.

His discussion, said the author, would tend to take the form "this is the theory but in fact we do it more simply." However silly this might appear, it was the correct approach. The designer of an airline operation must not sacrifice simplicity in a theoretical pursuit of economy or he would lose both. Procedures which were complicated or unrealistic seen from the flight deck would simply not be applied successfully.

Theory of Optimum Economy Cruise. For an airline with known cost characteristics, the cost of operating a Britannia on a particular flight could be assumed to be of the form:

$$\text{Trip cost} = AT + BF + C + \int_0^T \phi\,(p)dt \quad \ldots\ldots (1)$$

where A="hourly costs" \$/hr; B=fuel cost \$/lb; F=fuel consumed lb; C= fixed trip cost \$; $\phi(t)$=engine cost \$/hr; T=trip time hr.

The "hourly cost" referred to included those cost items which were truly variable with time and was not necessarily related to the "hourly direct operating costs" as the phrase is used in cost formulæ.

The engine cost was assumed in this equation to be a function of some engine operating parameter, p. On some piston engines a marked correlation had been observed between cruising power and maintenance and overhaul costs. In one case a marked saving both in premature engine changes and in overhaul material costs was observed by reducing cruise power by an average of 75 b.h.p. Comparable effects were difficult to observe on the Proteus 755/761. Premature engine withdrawals were not frequent and, so far as the author was aware, there was no known correlation between premature withdrawals and cruise technique within the currently permitted limits. In consequence, $\phi(p)$ must be considered a constant and may be added to A to give A_1.

Hence the general expression for trip cost gave:—

$$\text{Trip cost} = C + \int_0^S \frac{A_1 + Bf}{V_a + V_w} ds \quad \ldots\ldots (2)$$

where S=stage length, n.m.; f=fuel flow, lb/hr; V_a=T.A.S., kt; V_w=wind component, kt.

The derivation of the minimum value for this integral in the wind and temperature field of a particular flight was out of the question for manual computation, but would be perfectly practical for a suitable digital computer, integrating backwards from required landing weight in small segments. The problem was simplified by the limited number of flight levels, which gave a limit to the inputs required on performance, wind and temperature. It was believed that this method of operational planning was not currently in use.

Speed had a revenue application also. Apparently there were large numbers of people whose time was relatively valueless but

BRITANNIA: AN OPERATOR'S REPORT . . .

who would fly with airline X instead of Y because the schedule of X was ten minutes faster on a 1,000-mile stage. One waited in vain for Y to advertise: "Enjoy ten extra minutes of thrilling flight for the same low, low fare." If the competitive value of speed could be expressed in numerical terms, this could be fed into equation (2) by adding the competitive penalty of extra time to A_1 and proceeding as before. The equation then expressed the conditions for optimum economy.

Practical Procedures for Optimum Economy Operation. These were quite straightforward for the Britannia and were amenable to simple demonstration by making the approximation that maximum trip economy was achieved by operating at instantaneous maximum economy. This was an approximation because the planned gross weight of an aircraft at a point was affected by the intended method of cruising at subsequent points. The approximation was, however, quite acceptable, since the competitive value to be assigned to speed was so vague that excessive refinement would be out of place.

Consider flight at a fixed level, so that fuel flow might be considered a function of speed at a specified weight and air temperature. Then from equation (2):—

$$\text{Cost per nautical mile} = \frac{A_1}{V_g} + \frac{B}{\beta}$$

where V_g=ground speed; β=n.m./lb fuel (including wind effect)=specific range $\times \frac{V_g}{V_a}$

Hence minimum cost/n.m. occurred when

$$\frac{A_1}{B} + \frac{d\beta}{dV_g} = 0 \qquad \ldots\ldots\ldots\

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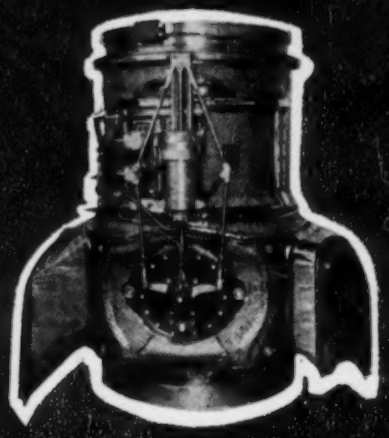
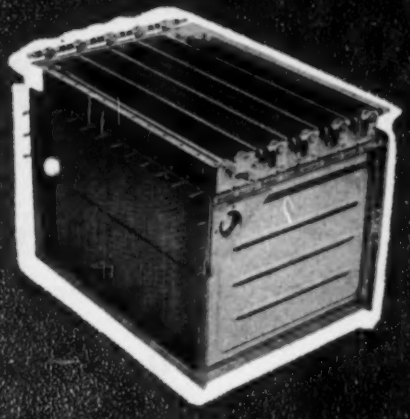


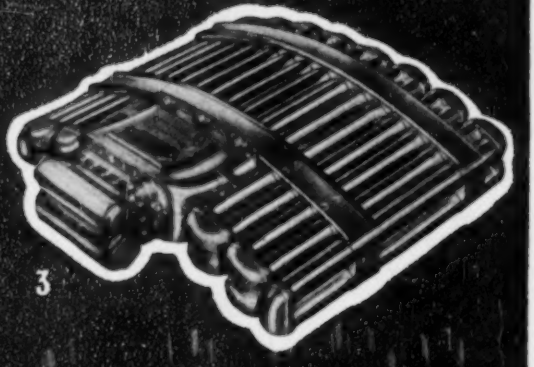
1

These thermal blankets are made of refractory fibre cased in .004 inch (.1016 mm) stainless steel. They are made-to-measure and are extremely light, the dimpled construction being responsible for their great strength. Specified for Rolls-Royce and Armstrong Siddeley jet and turbo-prop engines, these particular examples are shown fitted to the Rolls-Royce thrust reverser for the de Havilland Comet.



2

We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Vanguard's anti-icing system. Similar units are being supplied for the Fokker Friendship, the Bristol Britannia, the Armstrong Whitworth Argosy, the Vickers Viscount and the Handley Page Herald.



3

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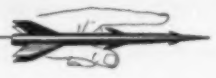


Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Engines for Light Aircraft

IF sporting flying can survive the Scylla of official antipathy and red tape it remains liable to founder in the Charybdis of cost, particularly in the provision of suitable engines; there is little hope for a new low-cost light aero engine because the demand falls far short of that which would justify mass production, the basic requirement for economic production.

The converted car engine solves this cost problem, but at the expense, hitherto, of a poor power : weight ratio and correspondingly reduced performance. However, a good power : weight ratio is only in degree less essential in cars than in aircraft and one may be confident that car manufacturers are not blind to the potential rewards in performance and economy to be gained by all-round weight reduction—indeed, the modern high-revving, 100-octane car engine already goes part of the way towards closing the gap between car and aero-engine performance.

Is it not logical to anticipate, as a further step in this direction, the introduction of a British lightweight air-cooled car engine to compete with those which have already appeared abroad? This should prove a reasonable prime mover for light aircraft, particularly if the engine designers could be encouraged to provide for such an application as far as were possible without prejudice to their primary objective.

The resulting unit might not be quite as perfect from the aviator's point of view as an engine designed purely for his benefit; but it should at least prove a marked advance on previous car-engine conversions and be sufficient for the needs of those who wish to fly for the fun of it. After all, sheer performance is not the only source of content and much satisfaction is to be had from getting the best out of what is available. Three-quarters of a loaf is far, far better than no bread.

Nicosia, Cyprus. F. P. U. CROKER.

Pressure Bulkheads

I WAS most interested in Roger Bacon's comment ["Straight and Level," November 14] on the concave/convex forward bulkhead of the Valiant. I remember that some years ago, as a pressure-vessel designer, I was surprised that Vickers should have gone to such structural complexity, and incurred a weight penalty, in order to achieve a bulkhead convex to the pressure. Possibly the old teachings have now been abandoned, but at one time all engaged on pressure-vessel design were warned of the pitfalls of such an arrangement.

The idea of adopting ends convex to the pressure came when vessels had to stand on end; the concave-to-pressure end wasted valuable space and required special feet for the vessel to stand on. So the bright idea came that, as the radius controlled the plate-thickness, then all that was necessary to obtain a higher working pressure was to reduce the radius. Thus was produced the reverse-curvature end—a so-called refinement of the simple dished end.

As can be seen, giving the end a central bulge could cause the plate to suffer partial collapse. Pressure, and particularly cycles of pressure, could cause the end to take up the slack and overfatigue the periphery of the plate by constant reversal of a bending load.

In the Valiant the segmental dishes in the bulkhead are similar to those of a double-curvature pressure vessel end. However, I expect that plenty of extra meat went into the structure to ensure "safetification" (U.S.A. jargon, *circa* 1958).

London, N.W.2. L. F. E. COOMBS.

Fogg Clearance

YOUR leading article "Outdoing Mr. Fogg" (December 12) praises in glowing terms the round-the-world flight of an R.A.F. Transport Command Comet 2, with particular emphasis on the fact that the aircraft completed its mission on schedule. "Not only had the de Havilland Comet arrived back on schedule," you say, "but it had reached each of its destinations—which included the first-ever landing by a Transport Command Comet at Hong Kong—on time."

I am not quite sure why you should marvel at this achievement. The Comet 2 has been flying all over the world, usually on schedule, for two and a half years. And what is so especially "splendid" about flying *round* the world? You can, if you have the money, do this by Pan American or Qantas any time you like.

Incidentally, I do not know why a first-ever R.A.F. Comet landing at Hong Kong should receive your acclaim. Civil airliners fly in and out of Hong Kong all day long, and it was in fact a Comet 4 which inaugurated the new runway last September.

The Comet's achievements are great, but (as another *Flight* reader asked recently) isn't it time we stopped boasting about them?

London, S.W.3. ADRIAN PRESMAN-WHITE.

CLUB AND GLIDING NEWS

APPRECIATION of the work of Maurice Imray as secretary of the Popular Flying Association, a post he recently resigned, was shown by members of the Association at a party at the Kronfeld Club, London, on December 9, when a well-filled wallet was presented to him on behalf of members by Harold Best-Devereux, the new chairman. During the rest of the evening "beer and bangers" were dispensed and news was exchanged.

Among P.F.A. activities under discussion were the imminent first flight (scheduled for December 13) of Rev. Patrick O'Kelly's home-built Turbulent G-APCN, begun in 1955 and assembled at Newtownards, Northern Ireland, a few months ago; the enviable flying rate of 10s per hour charged by the T.K. Flying Group operating Turbi G-AOTK (the eight group members also pay £1 10s per month each for hangarage and insurance); and the planned formation, by flying enthusiasts in the legal profession, of a Bar Flying Club.

PRAISE for the Currie Wot recently built by members of Hampshire Aeroplane Club (*Flight*, December 12), and for its designer, was expressed by Harold Best-Devereux at the club's recent annual dinner at Ampfield. Mr. Best-Devereux's toast to the club was answered by J. J. Dykes, a private owner.

The guests were welcomed by R. J. Stranger, who criticised the M.T.C.A. decision not to lay down a hard runway at Eastleigh, the club's base, because of the estimated cost and the proposed railway development at the northern edge of the field. "In this area," Mr. Stranger said, "civil aviation undoubtedly has to play second fiddle to any aspirations of the railways."

Replying on behalf of the guests, Maurice Imray, aviation secretary of the Royal Aero Club, referred to the forthcoming closure of Croydon and said, "We just have not got from the Ministry a policy which will help us in any way whatsoever. But we are going to fight to support your sort of flying and all it stands for."

The chairman of the club, Owen Hill, presided at the dinner. Following the speeches Harold Feltham presented a bouquet from club-members to Mrs. V. H. Bellamy, the wife of the club manager. Mr. Bellamy played a leading part in the Currie Wot project and carried out the first flights of G-APNT in September.

THE three-month period allowed for the submission of preliminary design studies for a French Government competition for a popular aircraft expired recently. Termed *aeronef de grande vulgarisation*, the new aircraft is apparently intended to put flying within the reach of as wide a public as possible. Over 50 design studies were submitted.

The selection committee has chosen the following nine designs which are to progress to the second stage, that of detailed design: Gatard Statoplan Hirondelle, Helicop-Air Combiné L.50, Labat Nomade, Legrand L.S. 60, Le Gris LG-21, Lemaire A.R.L.20, Morane Saulnier M.S. 880, R.A.C. Mignet H.M.370, and S.E.R.A. 01-A. A maximum of five prototypes will be built.

THE selection of a successor to F. N. Slingsby as managing director of Slingsby Sailplanes, Ltd., when he retires, is the subject of an advertisement in the current issue of *Sailplane and Gliding*. The company states that its successful record over the past 23 years has been largely due to Mr. Slingsby's leadership, but that "it is now necessary to think ahead and train someone to take the main burden in three or four years' time." The present vacancy is for a personal assistant to Mr. Slingsby at Kirbymoorside, and is expected to lead to a Board appointment within three years.

DURING the nine months since its formation, over 200 flying hours have been logged by the Yorkshire Territorial Army Flying Group, whose members operate a Tiger Moth based at Yeadon. Instruction for the group's 30 student pilots and three P.P.L. holders is given by Michael Procter and S/L. David Shaw.

CIVIL AVIATION

SILVER CITY FARE-CUTS

FURTHER penetration of the cross-Channel vehicle-ferry market is likely to result from Silver City's latest fare-reductions. These cuts—the ninth since operations began in 1948—were announced at a news conference given in London on December 11 by Mr. Eoin Mekie, chairman of Silver City.

On the company's busiest route, the 20-minute flight from Ferryfield (Lydd) to Le Touquet, the present cheap-rate winter fares will be extended from April 1 to June 1. From then on the rates for small and medium-sized cars will be 27½ per cent less than last summer's rates. For example, a Morris Minor will go for £5 single instead of £6 10s single. Likewise peak-period rates during summer weekends will also come down 27½ per cent.

On the routes Ferryfield-Ostend and Southampton-Cherbourg fare cuts of up to 37½ per cent are announced.

Government approval for a £3 5s day-return fare for passengers without cars flying to Le Touquet is meanwhile being sought.

By the end of this year about 65,000 cars and about 250,000 passengers will have been flown across the Channel by Silver City—a 50 per cent increase on last year's traffic, achieved by fare reductions of up to 50 per cent. The progress of Silver City's traffic, and its remarkable sensitivity to fares, was graphically illustrated on p. 83 of *Flight* for July 18.

FLOATING THE PRINCESSES?

TENTATIVE plans are being put forward to investigate the civil possibilities of installing six Proteus or Tyne engines in each of the three Saunders-Roe Princess flying-boats lying in storage at Cowes and Calshot.

A.V-M. Donald Bennett and Mr. Bennett Halpin have already approached the M.T.C.A. and the M.o.S. Not only are there obvious difficulties in obtaining clearance to operate a regular transatlantic service with these aircraft, but the M.o.S. might well have alternative plans (use of the Princesses as test-beds for a nuclear propulsion unit has been under consideration by the U.S. Navy for some months—see *Flight*, August 1).

HUNTING-CLAN'S BRITANNIAS

ON Thursday of last week the first of two Britannia 317s ordered by British Commonwealth and Shipping—joint owners with the Hunting Group of Hunting-Clan Air Transport—was delivered. Mr. Peter Masefield, managing director of Bristol Aircraft, handed the 317 over to Sir Nicholas Cayzer, chairman of the shipping company, at Filton.

The operational future of these two privately-owned Britannias remains, for the present, obscure. The fact that both are unpainted (though the particular aircraft handed over, G-APNA, bore the company's flag) indeed suggests some doubt as to whether they will in fact be operated by Hunting-Clan. As previously reported, this company—along with other independents—has tendered for the important long-haul trooping-contracts which are still awaiting allocation by the Government, and which are linked to the use of the three Britannia 250s bought by the M.o.S. for independently-operated trooping.

Meanwhile a decision from the A.T.A.C. is still pending on Hunting-Clan's application to operate cheap-fare inclusive-tour services to East and Central Africa.

Until these two matters are resolved it seems unlikely whether Hunting-Clan markings will be painted on the two Britannias concerned. Their disposal to another operator would be a sad outcome of the enterprising decision, taken two years ago, to order the aircraft.

This "proclamation of welcome and congratulations" was recently presented by the Mayor of Detroit, Mr. Louis Miriana, to a B.O.A.C. Comet 4 crew which visited the city—the first jet airliner to do so. Showing their appreciation of the gesture are, from left to right: Capt. T. B. Stoney, formerly flight manager Comets and recently appointed flight manager 707s; Capt. R. C. Alabaster, commander of the Comet concerned; Mr. Gilbert Lee, manager of B.O.A.C.'s western routes; Capt. R. E. Millichap, the new flight manager Comets; and B.O.A.C.'s managing director, Mr. Basil Smallpeice

FRIENDSHIP IN OPERATION

WITH little fuss or bother, the Fairchild F-27 has been steadily extending its scope of operation in the New World, and within the first three months of scheduled use will have made its presence felt from Rimouski in snowy Quebec, to Carupano, in the steamy Caribbean.

West Coast Airlines opened their first regular F-27 service on September 28, but on the previous day ex-President Harry S. Truman had become the first member of the public to fly in an American-built turbine airliner when he chartered one of W.C.A.'s three F-27s to fly from Olympia, Washington, to Portland. A fourth aircraft was delivered early in October and the last two of W.C.A.'s six Friendships are now in course of delivery. The load-factor achieved by West Coast in October and November was the highest in the airline's history for those months.

Aerovias Venezolanas (Avensa) were only a few days behind West Coast, and started operating F-27s from their base at Caracas on October 3. The five aircraft ordered by Avensa have now all been delivered (the airline has an option on a further three) and are operating on domestic services.

The next F-27s went north. On October 27 scheduled services using this type were started by Quebecair on their Montreal-Rimouski route. Their two Friendships operate this service either with a single stop at Quebec City, or with additional stops along the St. Lawrence at Seven Islands, Baie-Comeau and Forestville. Another northern operator to receive early delivery was the leading Alaskan carrier, Northern Consolidated Airlines. In early November N.C.A. started operations with the first of their three F-27Bs, these aircraft being distinguished by a forward freight door measuring 90×72in and by a movable forward bulkhead.

Piedmont Airlines had also received the first of their eight F-27s early in November and by the middle of the month had started scheduled services from their base at Winston-Salem, North Carolina. Piedmont originally had ordered twelve aircraft, but financing difficulties necessitated a reduction in the size of the order. Similar difficulties are believed to have led to delays in delivering the aircraft ordered by Mackey (two) and Bonanza (six, excluding options). The two F-27s ordered by Wheeler Airlines for non-scheduled operations in Canada are reported to have already been offered for sale.

Meanwhile new orders continue to come in. Aloha Airlines (once Trans-Pacific) have recently confirmed their order for three F-27s to be delivered next spring, with an option on two additional aircraft. Cubana are soon likely to announce an order for four. Fairchild firm sales now number 59 to airlines and 15 to corporations. Options on a further 22 bring the total order book to 96.

Sud Aviation's project for a small 8/10-passenger twin-turboprop transport, developed from the military SE.116 seen here, has attractive civil possibilities. Known as the SE.118 Diplomat, it will be powered by Turboméca Baston turboprops of 750 h.p. each. A Beechcraft 18 with two Bastans installed is now being flight-tested (picture: November 14)

RECORD PROFITS?

To reduce costs on medium haul routes, it makes sense to utilise the airliner with substantially lower operating costs than its competitors. This airliner is the new Vickers Vanguard! Lower costs are essential if fares are to be reduced to the level needed to attract the additional traffic which can ensure intensive utilisation and profitability.

All in favour say VANGUARD

This is no pipe-dream

At 65% passenger load factor the new Vanguard, in its 139-seater economy layout, can operate at 10% clear net profit with fares ranging from 29-50% below current tourist rates. In calculating these figures actual routes, current fares and current costs have been used.

Only the VANGUARD has all these features

425 m.p.h. cruising · Freight capacity 10 tons at normal densities · Full routeing and A.T.C. flexibility Can use normal existing airfields · Quick turn-round No airfield noise problems · Quiet, smooth flight Ten years' unique Vickers/Rolls-Royce jet-prop experience.

PROFIT with the NEW

On the Montreal–New York–Toronto triangle, with the most influential flight leg being 350 miles, with Vanguards and D.C.8's carrying the same amount of traffic, the Vanguard fleet would be operating at $8 million a year less.

VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE JET-PROP ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT600

"Heap on more wood! the wind is chill;
But let it whistle as it will,
We'll keep our Christmas merry still."
Scott

Christmas Greetings

and

Best Wishes for the New Year

from

Rotol Ltd and British Messier Ltd

CIVIL AVIATION...

THE VISCOUNT TRAGEDY AT BENINA

ON December 1 the Libyan Ministry of Communications published a report on the accident to a Central African Airways Viscount which crashed in the hills south-east of Benina in the early hours of August 9 this year. The court of inquiry into the disaster, which involved the loss of 36 lives (out of a total of 54 persons on board), is of the opinion that the pilot inadvertently descended below the correct height during approach, the probable cause of this action being "that he misinterpreted the reading of his altimeter." The court felt unable to exclude the possibility "that his efficiency had been reduced by fatigue and a slight indisposition."

In the absence of a suitably established accident-investigation organization within the Federal Government of Libya at the time of the disaster, a request was sent to the M.T.C.A. for technical assistance. In response, the Chief Inspector of Accidents made available the services of Capt. H. K. Gordon-Burge, a Senior Inspector of Accidents, for the preliminary investigation in Libya. On August 10 representatives of the Department of Civil Aviation of the Federation of Rhodesia and Nyasaland arrived at Benina with a request from their government that they might be included on the board of inquiry. An alternative suggestion was that the inquiry should be delegated to the Federal Government of Rhodesia and Nyasaland as the State of registry of the aircraft, in accordance with the provisions of Annex 13 to the Convention on International Civil Aviation (Chapter 5). It was subsequently agreed that the conduct of the Inquiry should be delegated entirely to the State of registry, provided that Mr. J. K. Sutcliffe, Controller of Civil Aviation in the Provincial Government of Cyrenaica, be included on the board to represent Libya.

The accident took place on Flight CE890, a scheduled C.A.A. service from Salisbury to London. This route is flown by three crews, one operating from Salisbury to Entebbe, the second from Entebbe to Benina and the third from Benina to London. On August 8 the service departed from Salisbury at 0713 hr and a traffic stop was made at Ndola. At Entebbe, Capt. Sindall and his crew took over for the sector to Benina. Stops were made at Khartoum and Wadi Halfa for refuelling and the aircraft left Wadi Halfa at 2120 hr for Benina; the flight was completely uneventful and slightly ahead of schedule up to the time of the accident. At 0112 the aircraft was cleared into Benina control zone. At the request of the pilot, at 0114, permission was given by Benina Approach Control to make a direct approach to Runway 330R, using the locator and responder beacons. Between 20 and 30 secs after the pilot had acknowledged this clearance the aircraft struck high ground 5½ miles to the south-east of the aerodrome. Fire broke out on impact.

The weather conditions prevailing in the Benina area were clearly described by the captain of an Argonaut that was following closely behind the Viscount. There was, he said, no upper cloud. At 14,500ft the lights of Benghazi were visible 45 miles out, but the aerodrome lights were not visible at that range. It was estimated that there was four-eighths low cloud in the Benina area, with tops at 2,000 to 2,500ft, and to the south-east of the aerodrome there was seven-eighths stratus which started at the edge of the aerodrome and extended for about 30 miles to the east and south-east. To the west and north of the aerodrome there was only two-eighths cloud with mist patches below. Patches of mist or low stratus on the base leg temporarily obscured the runway lights. Visibility on short final approach was good and estimated at five to six miles.

From the available evidence the court of inquiry reached eleven conclusions:—

(1) The aircraft was correctly certified and had been maintained in accordance with the approved maintenance schedule.

(2) The aircraft was correctly loaded, with the centre of gravity within the prescribed limits.

(3) No evidence could be found to suggest any mechanical failure or malfunctioning of the airframe, engines, propellers or other equipment.

(4) The crew held valid licences, were familiar with the route, and had not exceeded the prescribed flight-time limitations.

(5) All navigational and radio aids were fully serviceable on the ground, and there is evidence to show that the airborne equipment was also serviceable.

(6) The weather at the time of the accident was above Central African Airways' minima for an instrument let-down in Viscount aircraft.

(7) The aircraft had been cleared for a direct approach on to runway 330R and was in landing configuration when it struck the ground with the undercarriage extended, and with flaps lowered to the 32 deg position.

(8) If the pilot had established his position above the aerodrome by means of the locator beacon before descending below the minimum safe altitude it is unlikely that the aircraft would have struck the ground.

(9) There were no Central African Airways Corporation instructions to pilots at the time of the accident advising them against carrying out a direct approach to land using D.M.E. and locator beacon aids only.

(10) On the sector from Wadi Halfa to Benina the captain was sitting on the port side with the first officer in the second pilot's seat on the starboard side.

(11) The relatively high proportion of survivors is attributed to the large number of emergency exits fitted to Viscount aircraft, and the fact that all survivors had their safety belts fastened securely.

Three possible explanations were considered in determining why the aircraft was only 539ft above runway level instead of the 1,650ft laid down in the approach chart. The first two explanations—that the captain deliberately descended rapidly in order to break cloud, or that the altimeter millibar scale was incorrectly set—were dismissed, the weight of evidence pointing towards a misinterpretation of the altimeter reading by the pilot. The report notes that "after entering the cloud at 2,000ft the pilot would have been commencing the direct approach and his attention would, in all probability, be more concerned with the 100ft hand than with the 1,000ft hand, so that an error made before entering the cloud would have been maintained subsequently."

In considering the possibility of crew fatigue, the court noted that at the time of the accident the crew would have completed over 19 hr without sleep, of which 12 hr 44 min had been spent on duty, including 9 hr 30 min flight time. The effect on the pilot of this long period without sleep, coupled with a slight stomach indisposition and the fact that the flight ended in the early hours, "make it possible that his efficiency had been lowered to some extent."

KEEPING UP WITH THE JONESES

EXPERTS in and out of Congress are now urging the American airlines to re-appraise the self-imposed problems of the jet age and to devote a little more time to their financial homework.

Senator George Smathers, Florida's Democrat representative, is pressing for a senatorial investigation into the airline industry along the lines of last session's railroad inquiry. The senator, who is well versed in the field of transportation, feels uncertain whether the airlines' jet programme "is sound or whether it constitutes a reckless plunge into financial indebtedness which might ultimately be detrimental to the welfare and safety of the travelling public." Underlying his uncertainty is the fear that the industry will be "catapulted into financial distress to a point where the government will ultimately be called upon to pick up the tab."

The senator realizes that the crux of the problem is whether "traffic demands will permit economic use (of the jets)." It is this theme which provides Dr. Paul Cherington with the subject for his recent book, *Airline Price Policy*. Last June Dr. Cherington provided the White House with an evaluation of the airlines' jet procurement programme, and in the intervening months he has developed his ideas on the relationship of fares to markets and costs and to regulation. The airlines do not emerge unscathed from this examination, for "their managements appear often to have neglected pricing as a useful marketing or developmental tool." In particular, inadequate use has been made of market analysis in order to measure the precise fare levels that will yield optimum revenue. [*Contd. on page 956*

***Long-life tank:** The second production Comet 4, seen here in the water tank at Hatfield, has since June successfully completed the equivalent of 76,000 hours' "flying." This is equivalent to, say, 25 years of normal commercial operations. Every 2¼ minutes spent on test represent a typical four-hour flight. No failures or cracks have occurred; de Havilland are continuing the tests*

CIVIL AVIATION . . .

Dr. Cherington foresees "a downward pressure on prices" if capacity is to be filled satisfactorily. The peak problem that will arise from this development will demand an extensive application of off-peak reductions, possibly accompanied by an increase in certain on-peak fares. But to introduce such flexibility will require a reconsideration of C.A.B. policy.

The Investment Bankers Association of America have chosen an appropriate moment to enter the fray, and the paper presented by their Aviation Securities Committee at the Association's recent annual conference at Miami left no doubt about their fears concerning the airline industry's indebtedness. At the time of last year's conference, the airlines' shortage of funds amounted to $373m. By early summer this figure had reached $764m, but in recent months the level had dropped (primarily through PanAm arranging loans worth $130m) and by early November stood at $510m. T.W.A. accounts for two-thirds of the latest total, while most of the balance is needed by the medium-sized and smaller domestic trunks. Having themselves invested extensively in the airline industry in the past few years, the bankers are naturally reluctant to blame the carriers for the present financial embarrassment and instead put the blame on "C.A.B.-decreed ever-expanding competition." No mention is made of the fact that the airlines were never forced by the Board to take over new routes but indeed fell over each other in pushing for permission to operate new, competitive services.

EXCHANGING EQUIPMENT

LATEST symptom of the growing business in used-airliner disposals is the formation of an aircraft exchange in New York. To be known as Aircraft Exchange, Inc., it expects to open offices in London as well as in New York early in the new year and will deal with any transport aircraft of over 20,000 lb a.u.w.

Members will be able to forward quotations (for sale, purchase or lease) until each Tuesday afternoon, when the market will close to allow the various offers to be matched. The following afternoon the interested parties will be informed of any relevant developments and on each Thursday a weekly market report will be issued to members.

The exchange, says *Aviation Daily*, will be operated on a co-operative basis and will draw its members from manufacturers, airlines, investors and various official bodies. Robert Helliesen is president, and other leading officers are Charles Biondi, vice-president; Dr. Herbert Dorau, treasurer; Alfred Turino, secretary; and R. V. Hudnut, E. A. Merkle and Morton Wolovsky, Board members.

The U.S. Government, following suggestions put forward last June by Dr. Paul Cherington, is also engaged on a close study of the used-airliner market, and the Economic Division of the Air Co-ordinating Committee is expected soon to present a report on this subject.

CHALLENGE TO B.O.A.C.—1

SINCE the Eagle group of companies formed a Bermudan associate in 1957, the operations of this concern—Eagle Airways (Bermuda) Ltd.—have steadily consolidated. Daily Viscount services between Bermuda and New York have been operated with considerable success since May, and approval has been granted for this service to be extended to Montreal, Baltimore and Washington. Eagle have shown how, by registering a company outside the United Kingdom, the expansion of independent scheduled operations can be achieved.

Now comes news that the Bermudan Eagle company is seeking a licence to operate a service southwestwards from Bermuda towards the Caribbean—to Jamaica and the Bahamas. This application, as might be expected, is being strongly opposed by B.O.A.C. and their B.W.I.A. associate, the last-named company having the support of the Federal Government of the West Indies (which last month opposed a previous application by the Bermudan Eagle company to operate the Bermuda - Barbados - Antigua - Trinidad route).

The Eagle application to operate a service to Jamaica was heard before the Jamaican Air Transport licencing authority; and Mr. Harold Graham, president of the Bermudan Eagle company, said that the service would be of "immense benefit to Jamaica's tourist industry." Only the twice-weekly B.O.A.C. flight between Jamaica and London covered the route, he said, and the greater part of the seats were reserved for through-passengers, only "residual" seats being available at the last moment to local would-be travellers. He added that the route was not operated by B.W.I.A. The outcome of the hearing was not, as *Flight* went to press, known.

Further expansion of Eagle activities is suggested by a recent application of the Bermudan associate to the U.K. Air Transport Advisory Council to operate "a normal scheduled service with DC-6A/B and Britannia aircraft . . . between Bermuda and London with an intermediate technical stop at Gander and/or Shannon or else the Azores and/or Lisbon at an initial frequency of three return flights weekly increasing later to seven return flights weekly for ten years from the date of approval."

In other words, having established their Bermudan associate, Eagle see in this company the opportunity of legally challenging B.O.A.C. on an overseas route. Whether or not the A.T.A.C. approves the application remains to be seen; there is no doubt that it will be strongly opposed by B.O.A.C. The interesting aspect of the application is that it has the full support of the Bermudan government, whose flag the applicant flies.

The Prime Minister recently flew south by Silver City Heron from Warton, Lancs, after opening the new Preston motorway. Mr. Macmillan's flight was scheduled to go to Gatwick, where he would have been received by Silver City's chairman, Mr. E. C. Mekie, but fog at Gatwick necessitated diversion to Ferryfield

CHALLENGE TO B.O.A.C.—2

THE prospects of British holiday-makers being able to fly by Britannia to New York and back, having spent a fortnight there in a good hotel at an inclusive charge of £165, seems so remote as to be a mere exercise in wish-fulfilment. Yet this is the plan now being put forward by Horizon Holidays, Ltd., the U.K. travel agent, and Mr. Freddie Laker's independent company Air Charter.

The two concerns have jointly applied to the Air Transport Advisory Council to operate, as from March 1, 1959, one return I.T. flight weekly between London Airport (or Gatwick) and New York, frequency to be eventually increased to five services per week. This application has still to be considered by the Air Trans-

V.O.R. installations—eleven in all—have been ordered for distribution at selected points on the U.K. airways system. They have been purchased from Marconi (an example of their V.O.R. transmitter is seen here) by the M.o.S. on behalf of the Ministry of Transport. The purchase, say Marconi, "follows an exhaustive evaluation of V.O.R. equipment"

port Advisory Council. According to Horizon Holidays, the price of £165 is based upon a Britannia seating configuration of 110.

As is well known, Air Charter were quick to grasp the opportunity to operate Britannias when, during the summer, they acquired from Bristol, through their parent company Airwork, one of the surplus ex-Northeast Britannia 305s. This aircraft has been intensively used—averaging about eight hours a day since its acquisition—on long-distance trooping flights between the U.K. and Christmas Island under contract to the Government.

Thus Mr. Laker is now making plans for the commercial use of his Britannia, and the idea of a £165 inclusive tour to New York seems likely to win a big response from would-be British tourists to America. The sum of £165 is only £3 more than the return economy-class I.A.T.A. fare, which, of course does not include hotel and other travel expenses.

Again, whether or not such an application meets with the approval of the A.T.A.C.—or indeed the C.A.B.—remains to be seen; it is certain to be opposed by B.O.A.C. In considering such an application, the A.T.A.C. will have to decide whether it will constitute a "material diversion" of B.O.A.C.'s traffic, or whether it will create a new market. It may well be that the A.T.A.C. will feel, as they have done about independent airline applications to operate inclusive-tour services to the holiday resorts of Europe (i.e. to the areas served by B.E.A.), that such services do in fact create new traffic.

MORTON AND AIRWORK

IN reporting Airwork's acquisition of Morton and Olley Air Services, *Flight* suggested (November 21) that: "It may well have been the urgent necessity to leave Croydon, coming on top of a thin summer season, that forced Morton to look elsewhere for financial assistance, the likely cost of becoming re-established at Gatwick (or elsewhere) having long been a matter of concern to the airline's chairman, Capt. T. W. Morton."

This surmise has evoked a mild protest from Capt. Morton, who feels that it suggests that his company has been in financial difficulty. This, he wishes to emphasize, is not so. The reasons for the taking over of his airline by Airwork cannot, he adds, be revealed, except inasmuch as they were not the result of any financial difficulty.

Recent news from the airline—which will continue to operate as Morton Air Services—is that it has concluded an agreement with Pan American to provide a fast connection with the U.S.A. from Rotterdam. An interline agreement has been made whereby passengers are flown from Rotterdam to London on Morton's daily Heron service to connect with Boeing 707 services to New York. Departure from Rotterdam is at 0830 hr, and passengers are able to catch the 707 service leaving London Airport at 1100 hr. The Rotterdam - New York time is six hours shorter than that of the direct service from Schiphol by K.L.M. DC-7Cs.

BREVITIES

American Airlines announce that at Fort Worth on December 5 they took delivery of the first of their fleet of 35 Lockheed Electras.

* * *

The T.W.A. strike, which lasted for 16 days, ended on December 8 when 6,700 maintenance engineers who struck for higher pay returned to work with a wage increase of 44 cents per hour.

* * *

There have been 966 landings and 953 take-offs at Gatwick since October 1, according to the Minister of Transport, speaking in the House on December 3. Diversions from fogbound London have numbered 63.

* * *

The B.B.152 jet airliner built by the East German aircraft factory at Dresden made its first flight on December 5, seven months behind the original schedule. It is reported that Communist China is "very interested" in buying a fleet of these aircraft for internal routes.

* * *

Two new B.E.A. appointments are announced. Mr. Alfred A. Pigg, manager France since 1956, has been appointed regional manager at B.E.A.'s head office, in succession to Mr. W. C. Gaskin, who is retiring. Mr. A. C. Mills becomes sales manager Canada, based in Toronto. He was formerly in the London office as contract sales superintendent.

* * *

B.O.A.C. are planning to introduce Comet 4s on to the South African service towards the end of 1959. It is proposed also to run four Comet 4 services a week between London and Tokyo, starting next May and increasing to five in July; two a week to Hong Kong in May, increasing to three in July; two a week in August to Singapore; and five a week to Sydney towards the end of the year.

* * *

On Wednesday, December 10, the first American domestic jet airliner service was inaugurated when a Pan American Boeing 707-120, chartered by National Airlines in accordance with an equipment-lease arrangement approved by the C.A.B., flew from New York to Miami. This operation will be a daily one and schedules will be keyed in with Pan American's transatlantic services. National appear to be well placed to gain a large share of the lucrative Christmas holiday business to Miami from their competitors Eastern and Northeast.

The report of the West German Government's inquiry into the B.E.A. Elizabethan disaster at Munich last February has now been completed. It is to be sent to the Minister of Transport and Civil Aviation as this issue of *Flight* goes to press.

* * *

Independent Air Travel has been re-registered as Falcon Airways, a private company with a capital of £10,000 in £1 shares. The name of the purchaser is not disclosed, but previously it was reported that Mr. A. E. Cooper, M.P., had acquired ownership.

* * *

B.O.A.C. report that, on the eastbound New York to London route, Comet 4 services have been averaging 6 hr 45 min for the non-stop crossing. Last week the Boeing 707 set up a new eastbound record by making the crossing in a few minutes less than six hours.

* * *

Mr. Lewis Hector, a member of the American C.A.B., says that as a result of the Board's domestic-fares policy during 1958—which allowed certain fare increases and reductions of special discounts—an overall fare increase of more than 10 per cent was granted.

* * *

Mr. J. R. D. Tata, chairman of Air-India and president of I.A.T.A., said in Bombay on December 9: "I believe that differential fares for jet and piston-engine airliners will come into force in the next few years." He ruled out the possibility of a general increase in fares.

* * *

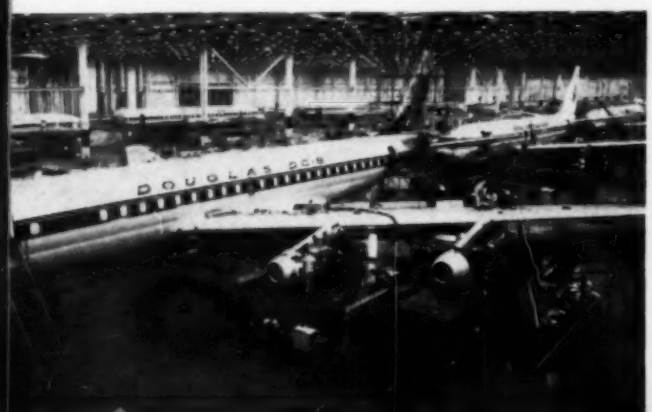
A Languedoc of the Spanish private airline Aviaco crashed on December 4 in the Guadarrama Mountains, about 35 miles from Madrid, *en route* from that city to Vigo. The 16 passengers and crew of five lost their lives. Aviaco operate a fleet of four Bristol 170s, six D.H. Heron 2s and, until the recent accident, eight Languedocs.

* * *

The first of six Comet 4s for Aerolineas Argentinas is expected to be delivered by de Havilland in February, which is the contract date. B.O.A.C.'s fifth Comet 4, G-APDH (Chester-built), was delivered to B.O.A.C. on December 6, nearly two months ahead of schedule. The next Comet for B.O.A.C., G-APDF, has since made its maiden flight and will be delivered before the end of the year.

* * *

According to Mr. B. A. Morris, a senior accident investigating officer of the M.T.C.A., the investigation into the accident to Hunting-Clan Viscount 732 G-ANRR on December 2 will take "at least two months or even longer." The wreckage has been taken to R.A.E. Farnborough. It will be recalled that the accident occurred 12 minutes after the aircraft took off from London on completion of an overhaul. The pilot, Capt. R. W. L. Mulliner, chief pilot of Hunting-Clan, reported that he had lost control soon after take-off. Five others on board lost their lives. They were Mr. Colin Lyon, first officer; Mr. Frank Harrington, radio officer; Mr. Robert Burns, ground engineer; Mr. Ronald Sadler, ground engineer; and Mr. Denis Godden, flight engineer.



Here is the impressive scene in the Douglas Long Beach DC-8 assembly plant, where can be seen aircraft for Pan American, United and T.C.A.

During an inspection of R.A.F. Khormaksar on his visit to Aden, the Duke of Gloucester drives past Venoms of No. 8 Sqn. The new form of marking adopted by the squadron can be clearly seen on the nose of the aircraft

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Ground Defence Director

APPOINTED Director of Ground Defence at the Air Ministry, G/C. K. W. Godfrey is to take over his new post on March 1 next year, with the acting rank of air commodore. He succeeds A. Cdre. J. H. Harris, who on the same date (as reported on this page, December 5) becomes Commandant-General of the R.A.F. Regiment.

G/C. Godfrey has been Deputy Director of Ground Defence since April 1955 and before that was O.C. the Aden Protectorate Levies. During the war, in which he commanded a wing of the R.A.F. Regiment on the invasion of Germany, he was twice mentioned in despatches and received the Croix de Guerre with Palm. He is also a C.B. and C.B.E.

Cyprus Reinforcements

AIR support for British troops engaged on anti-terrorist activities in Cyprus has recently been increased at the request of Maj-Gen. Kenneth Darling, the Director of Operations. The hard-working Sycamores of No. 284 Sqn. have been reinforced by six Whirlwinds from the Joint Helicopter Experimental Unit, carried out to the island (as shown in a photograph on this page last week) by Beverleys of R.A.F. Transport Command; and slow-flying, fixed-wing aircraft have also gone to Cyprus to assist in the work. These are Pioneers of No. 230 Sqn., whose rôle as an Army support unit was described in *Flight* for December 5, and Chipmunks. Two of the Pioneers were flown out by squadron pilots and the remainder were transported by Beverleys. The Chipmunk unit concerned is No. 114 Sqn.

No. 284 Sqn., which is now entering the third year of its operations in Cyprus, has achieved some remarkable successes in the past two years. Underlying them has been the quality of surprise introduced into terrorist searches by the agile Sycamores, "due to their ability [to quote *Flight's* special R.A.F. issue in June last year] to bring in troops out of the blue."

The squadron has initiated two techniques in support of anti-terrorist operations—night-flying and the landing of troops in mountainous terrain, sometimes at points where the Sycamores' landing-wheels can only just find a purchase. No. 284's statistics make impressive reading—over 16,000 sorties flown, 3,271 troops landed on operations, 113 tons of stores transported to security forces in the mountains; and when Field Marshal Lord Harding retired last year as Governor of Cyprus he said that the squadron had "contributed more to fighting terrorism on the island than any other single unit."

Malayan Honours

IN the *London Gazette* on December 9 it was announced that the Queen had been graciously pleased to approve the following honours and awards in recognition of distinguished service in Malaya:—

Honours

C.B.: A. V-M. V. E. Hancock, C.B.E., D.F.C., Royal Australian Air Force, A.O.C. No. 224 Group, Malaya.

C.B.E.: G/C. R. J. P. Prichard, O.B.E., D.F.C., A.F.C.

Awards

D.F.C.: F/L.s J. Hubicka, J. H. Liversidge, A.F.C., and C. E. Slater; Capts. M. G. Badger, C.R.E., and H. G. Crutchley, R.R.A.

D.F.M.: S/Sgt. R. W. Bowles, Army Air Corps.

B.E.M. (Mil.): F/Sgt. A. N. Patient.

Mentions in Despatches: S/L. R. F. Duncombe, R.A.F. Regt.; F/L.s B. R. Schroder, R. Strickland, R.A.F. Regt., C. Taylor and T. L. Thompson; F/O.s J. A. Wallace, R.A.F., and N. E. Wickland, R.A.F. Regt.; W/O. J. M. Ramage; F/Sgt. W. R. Rowe; Sgts. F. B. Gordon, A. Henshaw, F. J. James, R. P. Millyard, F. T. Robertson and G. E. Thacker; S/Techs. P. R. Hale, F. C. Huntley and L. A. Speakman; Cpl. A. Greaney; and J/Techs. R. M. Danton and R. G. House.

Air Marshal W. M. L. MacDonald, the new C-in-C. M.E.A.F., inspecting a guard of honour at A.H.Q. Episkopi when he assumed command. He was previously A.C.A.S. (Intelligence)

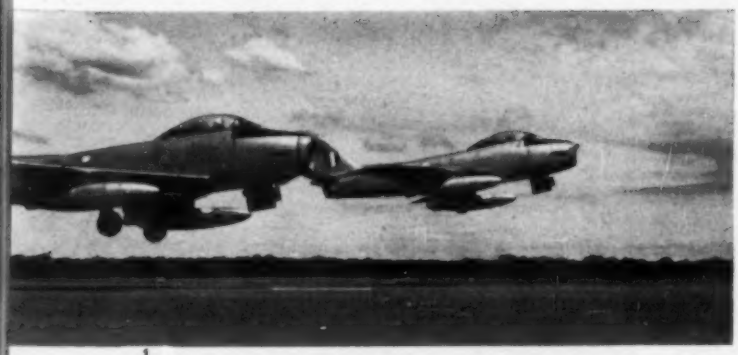
Two 1914 members and three former C.O.s of No. 5 Sqn. at its recent reunion. Left to right, W/C. G. J. C. Hogan (C.O. 1943, Burma); A. Cdre. H. le M. Brock (1914, France); F/L. S. P. George (1924, India); S/L. P. V. Ayerst (C.O. 1954, Germany); Lt-Col. L. Strange (1914, France); and S/L. T. P. Forgher, who commanded the squadron when it was disbanded last year

"Flight" photograph

Aden Award

IN recognition of his "gallantry and devotion to duty in air operations in Aden," S/L. E. W. Talbot, D.F.C., has been awarded a Bar to the Distinguished Flying Cross. Now commanding No. 84 (Communications) Sqn. at R.A.F. Khormaksar, S/L. Talbot won his D.F.C. in 1945 for the "great gallantry, courage and fine fighting spirit" shown by him during his tour in Bomber Command, when he took part in raids on the Ruhr and Pas de Calais.

OPERATION SABRE FERRY



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NINETEEN Avon-Sabres of No. 3 (Fighter) Squadron, Royal Australian Air Force, were recently flown by the squadron's pilots from their base at Williamtown in New South Wales to R.A.A.F. Butterworth in Malaya (where they are to form part of the Commonwealth Strategic Reserve)—a distance of 6,040 miles. This elaborate ferrying operation, the biggest peacetime movement of aircraft ever undertaken by the R.A.A.F., involved complex flight-planning and detailed safety precautions. It also meant pioneering a new air route from Australia to Malaya—via West New Guinea, the Philippines and Borneo—with Darwin as its starting-point.

Aspects of Operation Sabre Ferry pictured here are (1) two of the No. 3 Sqn. Sabres, which are Australian-built and were given navigational guidance on their route by R.A.A.F. Canberras, taking off from Williamtown; (2) pre-flight A.S.R. practice, in co-operation with an R.A.A.F. Neptune, for one of the pilots in a dinghy; (3) simulator training, by which the pilots were familiarized with details of their long journey; (4) W/C. C. Thomas, C.O. of No. 3 Sqn., giving some of his pilots a last-minute briefing; (5) getting aboard for 11½ hr flying, undertaken in five hops; and (6) G/C. G. Cooper, who commands No. 78 Fighter Wing (to which No. 3 Sqn. belongs), being welcomed at Butterworth by A.V-M. C. D. Candy, A.O.C. Home Command, R.A.A.F. With him are A. Cdre. K. R. J. Parsons, A.O.C. Butterworth (left) and A. Cdre. K. Stewart of No. 224 Group, R.A.F.

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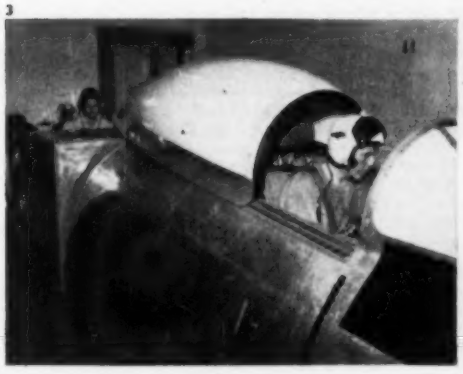

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THE INDUSTRY

H.T.P. by a New Process

THE photograph on the right shows a night scene at the £2,500,000 facility for the production of high-test peroxide commissioned last month by Laporte Chemicals, Ltd. The new H.T.P. plant is situated at Laporte's Baronet Works at Warrington, Lancs, and it will help the company to double their output of this strategic fluid.

A new process is employed in the new plant. Originally H.T.P. was extracted by an electro-chemical process which is prodigal in the use of electricity, steam and cooling water. Full details of the method employed in the new installation may not be divulged for reasons of security, but the following are the main essentials. Butane (from the Shell refinery at Stanlow) is cracked to yield hydrogen; there follows an autoxidation organic cycle and a hydrogenation cycle in which palladium is used as a catalyst; the organic solution forms an intermediate, the actual ingredient chosen being 2-ethyl anthraquinol; the final aqueous product contains approximately 20 per cent hydrogen peroxide. This solution may be sold directly, but most of it is purified and distilled to yield concentrations of 50 per cent and upwards. H.T.P. has a strength higher than 85 per cent.

Apart from its manifold uses in the fields of textiles and related industries, H.T.P. is now widely employed, particularly in the United Kingdom, as an oxidant for rocket propulsion. Numerous aircraft rocket motors and guided weapons are known to operate on H.T.P. (and, usually, kerosine), and the H.T.P. from the new Laporte plant will also be supplied to the Royal Navy as the prime propulsive fluid of two experimental submarines (this system was pioneered by the German Navy before 1945 and is well-known), and as a propellant for torpedoes. Rocket motors known to operate wholly or partly on H.T.P. include the Armstrong Siddeley Gamma, the de Havilland Super Sprite and Spectre and the Napier Scorpion family.

Data on Materials

SERVICES offered by Materials Data, Ltd., of 273 Farnborough Road, Farnborough, Hants, have recently been amplified in response to suggestions by clients. The organization is now arranging to publish, at frequent intervals, lists of materials arranged in indices according to their properties or merits, so as to assist rapid design selection. These have been calculated by computer, and the results of the first Materials Data survey are being published in three parts, under the headings (1) mainly mechanical properties; (2) mainly thermal and electrical properties; (3) thermal, electrical, mechanical ratios (i.e., mixed indices). The Materials Data Centre membership fee of seven guineas for the coming twelve months includes receipt of these publications and use of the centre's facilities.

Day at Fawley: The Esso Petroleum Company's vast oil refinery at Fawley, Hants ("Flight," November 5, 1954), is being extended by the addition of a £10m petro-chemical plant. The chief products will be ethylene, heptenes, sulphur and butadiene; this is a view of the circuit for the last-named, which is the raw material for nylon, synthetic rubbers and a wide range of synthetic lubricants

Night at Warrington: Part of Laporte Chemicals' new hydrogen peroxide plant, subject of the first news-item on this page

Airport Builders' Buildings

NINETEEN Arcon prefabricated buildings have been assembled in record time at the site of the £2¼m Nandi Airport project, Fiji, the first shipments of parts from the U.K. having been made only two weeks after the order had been placed.

The buildings, which are to house European staff working on the site and to accommodate offices, stores and workshops, have been supplied by Taylor Woodrow (Building Exports), Ltd., the marketing members of the Arcon Group of prefabricated building manufacturers. The airport project is being carried out by Taylor Woodrow (Overseas), Ltd., in association with D. B. Waite of Auckland, New Zealand, for the N.Z. Ministry of Works.

IN BRIEF

G/C. Arnold H. Mielke, until recently Director of Material Procurement at R.C.A.F. Headquarters, has been appointed vice-president of the Western Division of Canadian Aviation Electronics, Ltd., with headquarters in Winnipeg.

* * *

Rist's Wires and Cables, Ltd., inform us that they "are very proud to have been associated with two recent British achievements"—the world water-speed record set up on Lake Coniston by Donald Campbell's *Bluebird* and the inauguration of Atlantic schedules by the Comet 4.

* * *

J. Peers and Associates, Ltd., the advertising practitioners, of Summit House, 1-2 Langham Place, London, W.1, have published an attractively produced book describing the publicity side of the British engineering industry and what is involved in the business of selling its products.

* * *

Mr. E. Marland has been appointed commercial manager of the capacitors and resistors division of the Plessey Co., Ltd., at Swindon. He joined the company in 1953 as a technical representative for the aircraft electrical division, later becoming contracts manager and eventually sales and commercial manager of the wiring division.

* * *

Mr. L. Murray-Stewart, who has been underwriter and manager of the Aviation and General Insurance Co., Ltd., since its incorporation is retiring on December 31 and will be succeeded in both capacities by Mr. C. R. Jeffs as from January 1 next year. Mr. P. E. Mortimer, assistant underwriter, who is approaching retirement age, will continue in office.

* * *

Three appointments to the Board of Hadfields, Ltd., parent company of the Hadfields group, have been announced. The new directors are Mr. Fred Cousans, F.I.M., who joined Hadfields as foundry superintendent in 1947 and was made local director the same year; Mr. George Wood, A.Met., A.I.M., who in 1935 joined Hadfields as a metallurgist in the research department and in 1945 was promoted assistant research manager; and Mr. R. C. Heys, managing director of Millspaugh, Ltd., a Hadfields subsidiary.

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40

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quoting reference F 1799J.

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AIRCRAFT DIVISION

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Increased commitments for development of the P.1B aircraft have created opportunities for young stressmen in our design establishment at Warton. The positions offered are suitable for men, with a degree or Higher National Certificate and a few years experience in an aircraft stress office, who are seeking a permanent position with one of Britain's most progressive aircraft companies.

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FLIGHT and AIRCRAFT ENGINEER

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Advertisement Rates. 5/- per line, minimum 10/-, average line contains 6-7 words. Special rates for Auctions, Contracts, Patents, Legal and Official Notices, Public Announcements, Public Appointments, Tenders 6/- per line, minimum 12/-. Each paragraph is charged separately, name and address must be counted. All advertisements must be strictly prepaid and should be addressed to FLIGHT Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1.

Postal Orders and cheques sent in payment for advertisements should be made payable to Iliffe & Sons, Ltd., and crossed & Co.

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers. For the convenience of private advertisers, Box Number facilities are available at an additional charge for 2 words plus 1/- extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to "Box 0000, c/o Flight," Dorset House, Stamford Street, London, S.E.1.

The Publishers retain the right to refuse or withdraw advertisements at their discretion and do not accept liability for delay in publication or for clerical or printer's errors although every care is taken to avoid mistakes.

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January 2, 1959, issue closed for Press first post today, December 19, 1958.

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GEMINI 3B. Cirrus Major engines. Single engine performance. V.H.F., A.D.F., etc. £2,750.
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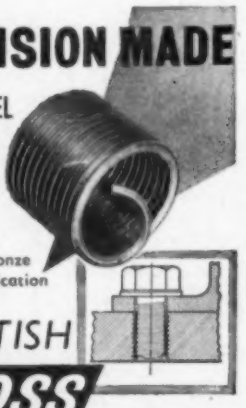

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned application to operate a scheduled air service:—

FROM Rotorports, Ltd., of 87 Regent Street, London, W.1:—

APPLICATION No. 2380 for a Helicopter service initially with S.58, Vertol 44 and Bell 47J aircraft and later also with Westminster and Rotodyne aircraft for the carriage of passengers, supplementary freight and mail on the route London Airport - London (York Road) and/or London (Nine Elms) and/or Southend and/or Manston and/or Rochester at an initial frequency of five return flights daily increasing in accordance with traffic demand for ten years from 1st July, 1959.

THIS application will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to this application must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the application may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [8576

AIRCRAFT SPRING WASHERS

TO B.S. SPECIFICATION S.P.47
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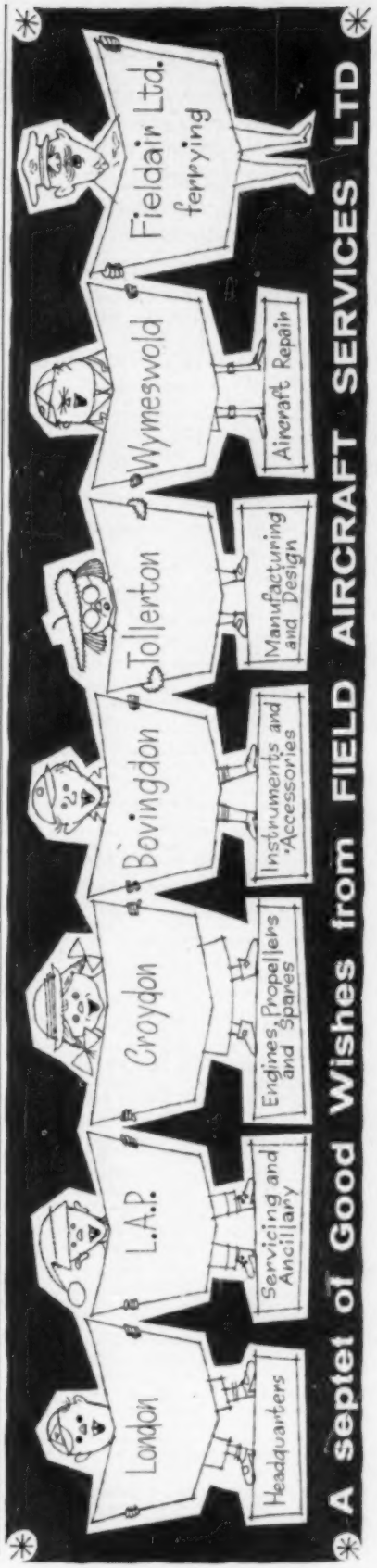

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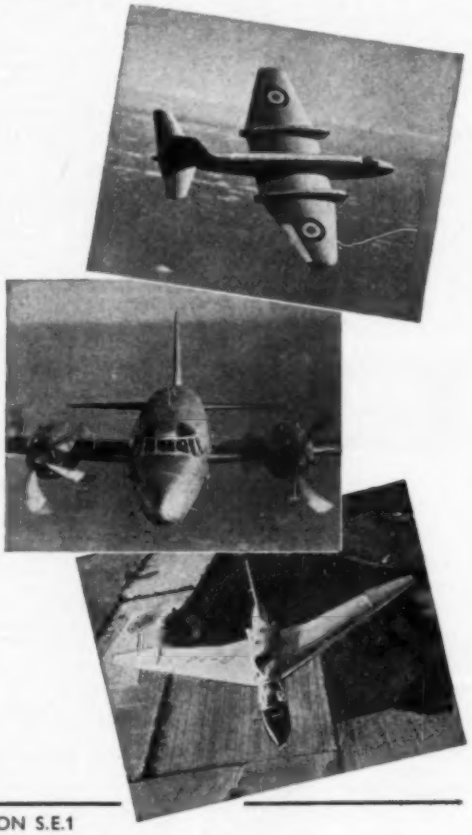

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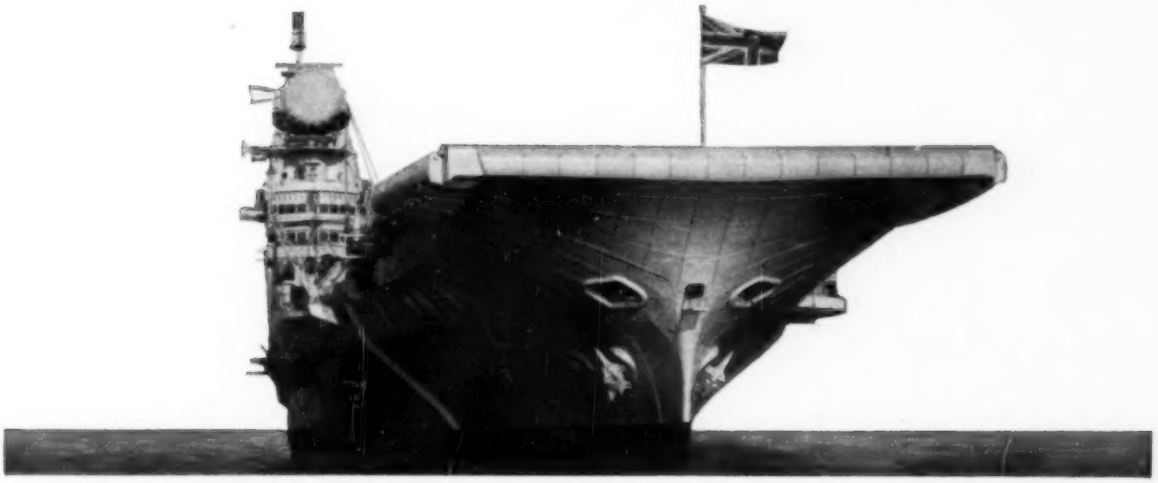

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